

1,055,525.

Fig. 2



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UNITED STATES PATENT OFFICE.

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ART OF AND APPARATUS FOR RECORDING AND REPRODUCING SOUND.

1,055,525.

Specification of Letters Patent.

Patented Mar. 11, 1913.

Application filed April 17, 1908. Serial No. 427,691.

To all whom it may concern:

Be it known that we, VICTOR H. EMERSON and GEORGE A. MANWARING, citizens of the United States of America, residents of New York city, New York, and Bayonne, New Jersey, respectively, have invented new and useful Improvements in the Art of and Apparatus for Recording and Reproducing Sound, which improvements are fully set forth in the following specification.

Our invention relates to talking-machines and is based upon the use of the selenium cell. It has long been known that selenium possesses the peculiar property of becoming more electro-conductive in the presence of light,—or stated reversely: its electrical resistance diminishes as the light increases. This property has been utilized by various forms of apparatus known as "selenium cells" which are inserted in an electrical circuit and provided with means for regulating the admission of light upon the cell. Such cells are very sensitive in responding to slight variations in the amount of light.

The utilization of our present invention comprises a talking-machine employing the principle of the telephone and that of the selenium cell, namely: there is a diaphragm actuated by an electro-magnet; the electro-magnet in turn is actuated by an electric current; and this current is modulated in intensity by means of the varying resistance imparted to a selenium cell included in the circuit. This varying resistance is imparted to the selenium cell by means of a special sound-record,—the latter being a sort of "stencil" which admits more or less light to the selenium cell, the amount of light admitted corresponding to the sound-waves. Consequently the electric undulations in the circuit, and the resultant audible vibrations of the diaphragm, correspond to the sound-waves.

The present invention consists in the manner of producing the special sound-record or "stencil" record for such service, and further in the various details pointed out and claimed.

We have also invented the stencil record itself, and the apparatus for utilizing it, as well as the method of reproducing sound, all as hereinafter pointed out; but do not claim the same in the present application.

The invention will be best understood by

describing the details of preferred embodiments thereof.

In the annexed drawings, Figure 1 represents, conventionally, but greatly enlarged, a portion of a stencil record such as may be used for the purpose indicated; Fig. 2 is a vertical section of a reproducing apparatus, embodying our invention; and Fig. 3 is a transverse section of a detail of Fig. 2.

One way of making the stencil record is as follows: We first produce an "original" sound-record of the up-and-down, or vertically-undulating, type. That is to say, a V-pointed recording-stylus is caused (by sound-waves) to vibrate up and down, being embedded into the surface of a revolving recording disk of the usual wax-like material, while the stylus is simultaneously fed across the disk,—in order to produce a spiral record-groove having vertical irregularities of varying depth, such for example as set forth by Bell and Tainter Patent No. 341,214, of May 6, 1886. The stylus is of the usual type employed in making records of this character, and owing to its taper (its end being substantially V-shaped) the deeper the cut, the wider it will be. Consequently, such a record-groove corresponds to the sound-waves not only in its variations of depth, but also in its variations in width. The surface of this "original" record-disk is then rendered electro-conductive in any convenient manner (as by coating it with finely powdered graphite), and an electroplate obtained therefrom (conveniently of copper). From this first or negative electroplate we obtain, by any of the well-known processes, a second or positive electroplate, which will be an exact copy of the original sound-record. It will be a plane metal surface having a groove of varying depth, and, as explained before, of varying width. The deeper the cut, the wider it will be; consequently since (as is well known) the vertical irregularities or variations in depth correspond to the sound-waves, so also the lateral variations—the variations in width—will likewise correspond to the original sound-waves. This second or positive metal plate is then used as a printing-plate. Any suitable ink is applied to its surface, and then imprinted upon a sheet of paper. This printed sheet of paper (Fig. 1) will appear as a black field

having a spiral blank space, or succession of spaces, 30 (where no ink has been deposited). This blank space 30 corresponds to the superficial shape of the record-groove of the printing-plate (and of the original sound-record). The paper may be any ordinary paper; or it may be treated beforehand to render it more translucent; or such treatment may be applied after the paper has been printed, as, for instance, by "waxing" the printed sheet. This new sound-record may be defined as a "stencil", being an opaque sheet or disk 20 having a translucent portion 30 corresponding, in variations of width, to sound-waves. The "record" proper is made up of a succession of lakes 30 as it were, as illustrated in Edison Patent No. 430,278, dated June 17, 1890 (Fig. 9 thereof); and it differs from the tracing shown in Fig. 5 of Berliner Patent No. 732,786, dated Nov. 8, 1887, in that the line *y* of the latter is not "of varying width", nor is it described as "translucent".

Referring now to Fig. 2, 11 is a table or frame-plate, beneath which is indicated a battery 12 having the circuit 13—13. At 14 is the core, and at 15 the windings, of an electro-magnet in the circuit 13, in front of which magnet is a suitably-supported diaphragm 16, from which extends a sound-duct 17, leading to the horn 17'. The selenium cell included in the circuit 13, is indicated at 18. Broadly stated, we provide in the electric circuit a selenium cell and a telephone. In front of the selenium cell, we provide a revoluble and laterally-progressing carrier 19, which may be a sort of spider or ring (or a disk of glass or other transparent material) upon which our stencil record 20 is detachably secured by any convenient device (not shown). On the front side of the record 20, we locate a lamp or other source of light 21; and, between the record 20 and the selenium cell is an opaque shield 22 having a narrow transverse slit 23 (see Fig. 3). The selenium cell will further be protected from light by a removable opaque housing 24. Suitable means (not shown) are provided for rotating the carrier 19 and the record 20, while causing them to progress laterally in front of slit 23.

The operation is now obvious: When the apparatus is started, the stencil record 20 is caused to revolve and to progress in front of the slit 23, the rate of progression being correlated to the pitch of the spiral record-path 30; so that this blank space 30 will, in its successive convolutions, be passing continuously in front of the slit. The stencil record 20 acts as sort of shutter in admitting more or less light through the slit 23 and upon the selenium cell 18; the wider the blank space 30, the more light will be admitted to the selenium cell; and the longer each particular "lake" or enlargement in

the blank space, the longer will be the period of time in which light is being admitted to the selenium cell. In short, the quantity of light admitted to the cell, and the duration of the admission of light, correspond exactly to the intensity and duration of the original sound-waves. From this it follows from the principle of the selenium cell, that its electrical conductivity is increased and diminished precisely in accordance with the sound-waves; consequently the electro-magnet 14—15 has its energy increased and diminished in precise accordance with the sound-waves; and the diaphragm 16 is vibrated accordingly, and gives forth sounds corresponding precisely to the original sounds whose waves had been recorded and then copied graphically upon the stencil record 20.

It will be understood of course that the apparatus just described is merely one embodiment of an apparatus for carrying out our invention, and for utilizing a stencil record obtained as heretofore described or otherwise.

While we have described our record as in the form of a disk having the translucent spaces arranged in a spiral, it is manifest that a tape, or an endless belt, might be employed; and the translucent spaces might extend in a continuous straight line or otherwise. Furthermore, the terms "opaque" and "translucent" are relative, the gist of this part of our invention consisting in the sound-record having variations of translucency corresponding to sound-waves. For instance, the path indicating the sound-waves might be the opaque portion while the field of the record would be translucent; and the whole article might be more or less translucent, but the part corresponding to path 30 markedly more so and with its translucency varying in accordance with sound-waves. Such articles would still be within the spirit of our invention. Again, since the two sides of the record-path 30 are similar, only one side of such record might be employed for obtaining audible reproductions. Therefore, the employment, in modulating the admission of light to the selenium cell, of a zig-zag record-path of uniform width, as illustrated in Fig. 5 of the Berliner Patent No. 732,786 (heretofore mentioned), by using only one-half of such record, would be within the spirit of our invention. It will also be understood that our stencil record may be obtained by other means or processes than above set forth. And other changes may be made in the construction and arrangement, and in details, without in any case departing from the spirit of our invention, which broadly consists, first, of a sound-record presenting variations of translucency corresponding to sound-waves; and, second, in reproducing sounds by mod-

ulating (in accordance with sound-waves) the amount of light admitted upon a selenium cell, and thereby correspondingly actuating the diaphragm of the talking-machine.

5 Having thus described our invention, we claim:

10 1. The process of producing a sound-record, which consists of first producing in a tablet of suitable material a record-groove of varying width corresponding to sound-waves, obtaining therefrom in hard material an exact duplicate of said original record-groove, and finally printing the surface of the latter upon a translucent sheet.

15 2. The process of producing a sound-record, which consists of producing in suitable material a record-groove of varying width corresponding to sound-waves, and printing therefrom upon a translucent 20 sheet.

3. The process of producing a sound-record, which consists of first producing in a tablet of suitable material a record-groove

of varying width corresponding to sound-waves, and then producing therefrom upon 25 a sheet of suitable material a sound-record consisting of areas having translucency different from that of the rest of the sheet, the widths of said areas varying in accordance with the sound-waves.

30 4. The process of producing a sound-record, which consists of first producing in a tablet of suitable material a record-groove of varying width corresponding to sound-waves, and then producing therefrom an 35 opaque sheet having a translucent path of varying width corresponding to sound-waves.

In testimony whereof we have signed this specification in the presence of two sub- 40 scribing witnesses.

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