

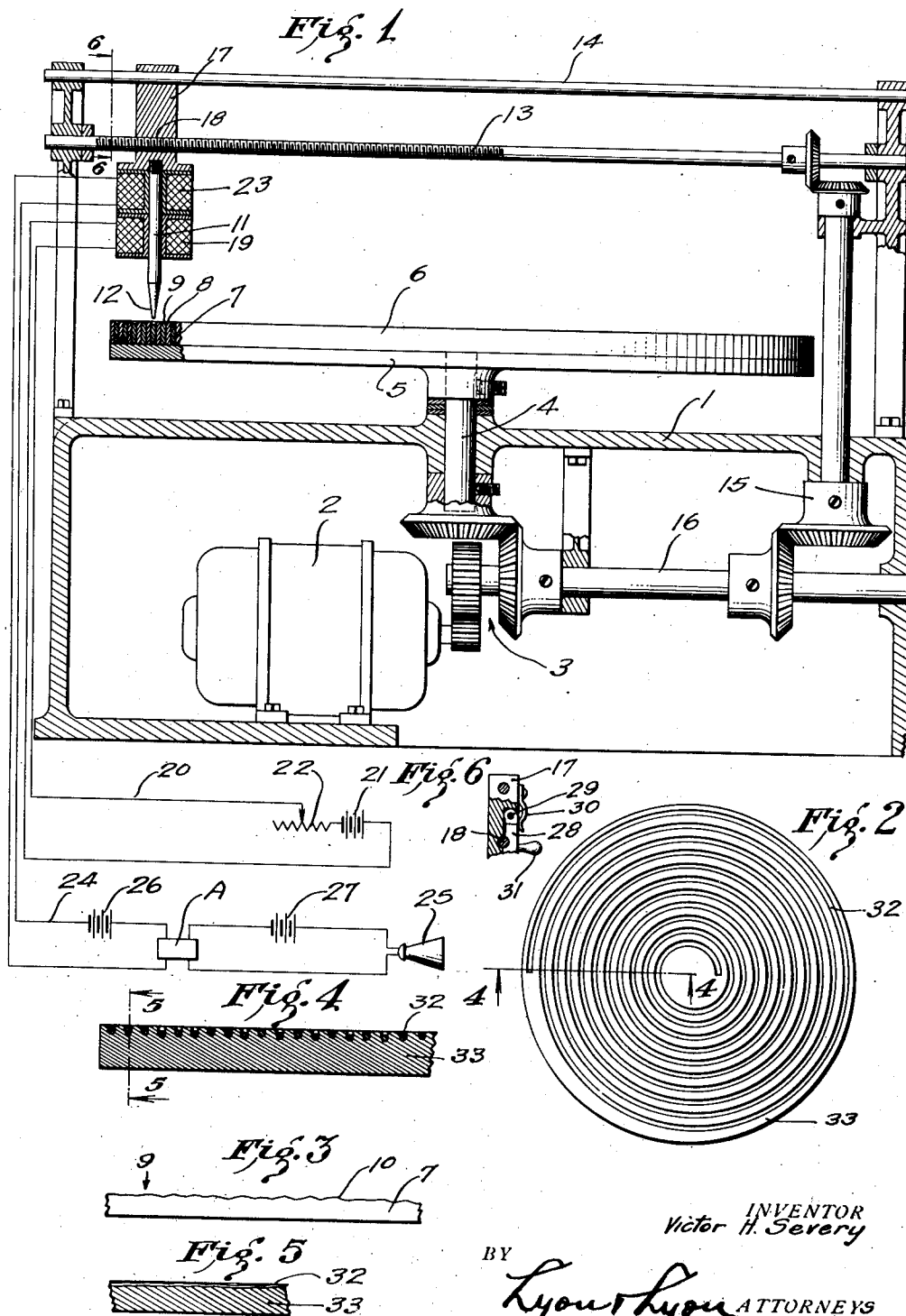
Dec. 19, 1933.

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MAGNETIC SOUND REPRODUCING METHOD

Original Filed March 3, 1930 2 Sheets-Sheet. 1



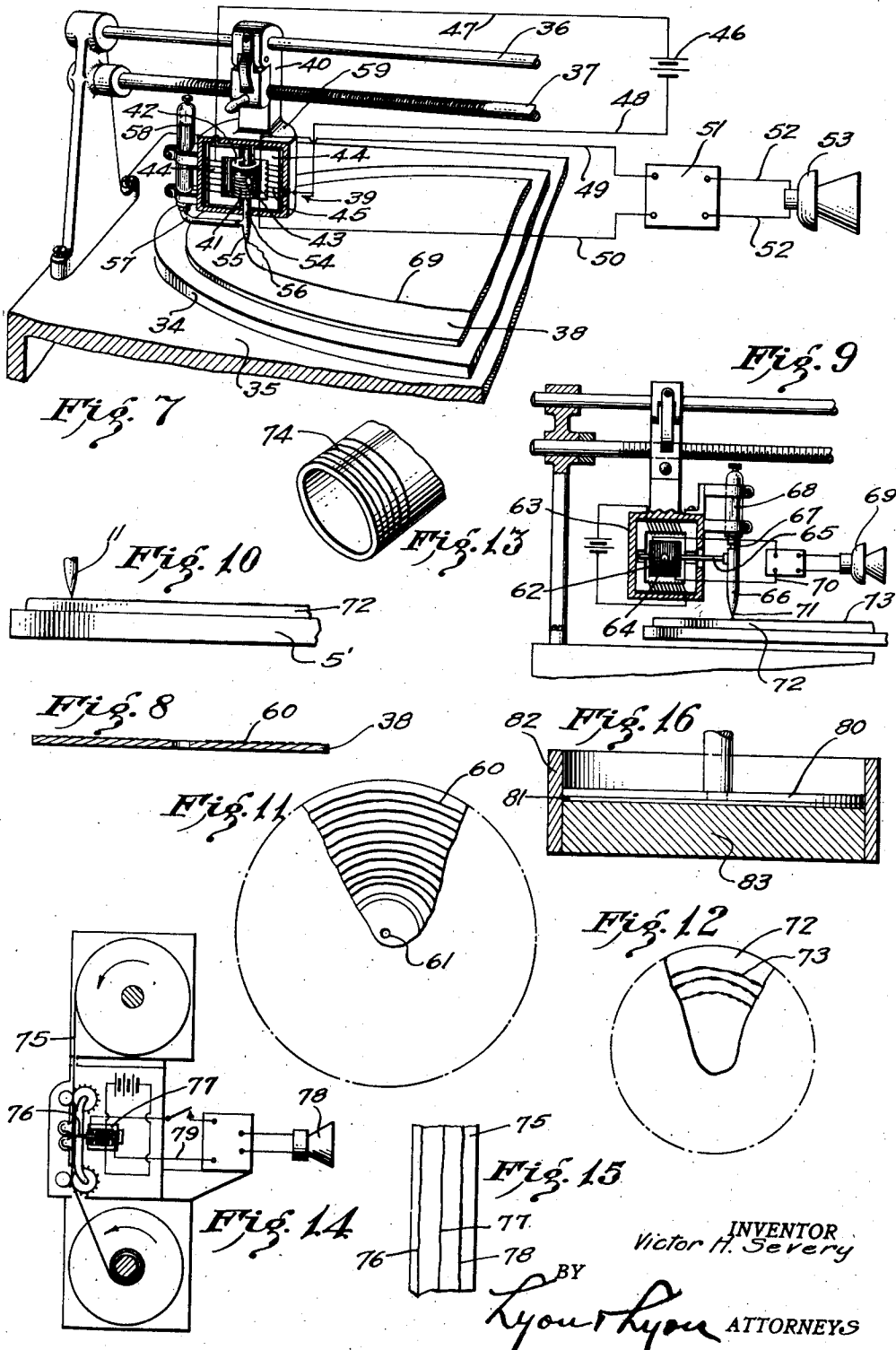
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MAGNETIC SOUND REPRODUCING METHOD

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INVENTOR
Victor H. Severy

BY
Lyons & Lyons ATTORNEYS

UNITED STATES PATENT OFFICE

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MAGNETIC SOUND REPRODUCING METHOD

Victor H. Severy, Los Angeles, Calif., assignor to
The Electrotone Corp. of America Ltd., Los
Angeles, Calif., a corporation of California

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Renewed March 6, 1933

3 Claims. (Cl. 179—100.2)

This invention relates to a novel method for producing records for use in a sound reproduction. The record embodying this invention can be employed in sound reproduction in apparatus of the phonograph type and is distinguished by the fact that in the operation of the method and apparatus it is unnecessary for the stylus to touch the record.

The general object of the invention is to provide an efficient method which will enable a record for sound reproduction to be produced, from which sound can be reproduced without necessitating actual contact between the stylus of the instrument and the record which controls the production of the sounds.

Further objects of the invention will appear hereinafter.

Before proceeding to a detailed description of the invention, it should be stated that in practicing my invention, I form a record having an elongated magnetic metallic element with its face disposed in waves corresponding to the recorded sounds to be reproduced. With this record I employ a stylus which is supported with one end disposed adjacent to this element. In the apparatus, I provide means for causing a relative movement between the element and the stylus to cause the end of the stylus to traverse the length of the element. Associated with the stylus, I provide electric means that cooperate with the stylus to produce sounds corresponding to the waves of the element.

The invention consists in the steps and combination of steps of my novel method, all of which contribute to produce an efficient method for effecting sound reproduction.

A preferred embodiment of the invention is described in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawings:

Figure 1 is a vertical section through apparatus for practicing my invention, certain parts being shown in elevation and only partially in section. This view diagrammatically indicates the electric circuits which may be employed in connection with the apparatus.

Figure 2 is a plan of a record produced in accordance with my method embodying my invention upon an enlarged scale.

Figure 3 is a side elevation of a short section of an element such as I may employ in the practice of my invention.

Figure 4 is a cross section taken about on the

line 4—4, Figure 2, and illustrating another form the record may take.

Figure 5 is a developed section taken in the position of the line 5—5, Figure 4.

Figure 6 is a vertical section taken about on the line 6—6, Figure 1, but upon a reduced scale.

Figure 7 is a perspective broken away and illustrating a portion of apparatus of the type illustrated in Figure 1, but adapted to the production of a record from sounds that are to be reproduced.

Figure 8 is a vertical section through a record of the type that can be produced through the agency of the apparatus illustrated in Figure 7.

Figure 9 is an elevation in partial section with parts broken away, illustrating another embodiment of recording apparatus such as illustrated in Figure 7.

Figure 10 is a diagrammatic view showing a portion of a record of the type produced by the apparatus illustrated in Figure 9 and illustrating how the same cooperates with the stylus to reproduce music or other sounds when used in connection with the apparatus illustrated in Figure 1.

Figure 11 is a plan, partly broken away, and illustrating the type of records which can be produced by the apparatus illustrated in Figure 7.

Figure 12 is a view similar to Fig. 11 but illustrating the character of record produced by the apparatus illustrated in Figure 9.

Figure 13 is a perspective showing one end of a record of cylindrical form in which the record is of the character illustrated in Figure 11 but formed upon a cylinder instead of a disk.

Figure 14 is a diagrammatic view illustrating the way in which my invention can be practiced in order to produce a continuous record on a continuous web or film.

Figure 15 is a plan of a short section of a record of the type which can be produced in the type of apparatus illustrated in Figure 14.

Figure 16 is a section illustrating how my invention adapts itself for effecting reproduction of the record in large quantities.

I shall now proceed to describe the preferred embodiment of my invention.

In Figure 1, I illustrate a simple form of an apparatus including a casing 1 provided with a motor 2 of any suitable kind having means such as gearing 3 for driving a vertical spindle 4 mounted in the casing, said spindle carrying a platen 5 secured to the upper end of the

spindle 4 to be rotated like the platen of an ordinary phonograph. If desired, a spring motor of any suitable construction may be substituted for the motor 2 which is illustrated as an electric motor. Supported centrally on the platen 5 (which is of circular form), I provide a record 6. This record is formed so that it carries a record element 7 which is in the form of a continuous spirally coiled strip of a magnetic metal such as steel. This strip is quite thin and may be wrapped around to form the record 6 by wrapping with it an insulating strip 8 which extends continuously between the wraps of the element 7.

The face or edge 9 of the element has been previously formed with waves 10 (see Figure 3) which correspond to sounds, such as music or speech, to be reproduced.

Figure 3 shows a short section of such an element but it should be understood that in this view the waves 10 are illustrated as greatly exaggerated.

Above the record 6 I mount a stylus 11 which is supported and guided in such way as to cause it to traverse the entire length of the coil element 7 while maintaining its lower end 12 (preferably pointed) directly over the element at all times.

Any suitable means may be employed for this purpose. In the present instance this may be accomplished by providing the apparatus with a feed-screw 13 that is disposed above the record 6 and passing through the vertical axis of the spindle. In other words, this screw extends in a diametrical direction across the disk 6. Means is associated with the feed-screw for guiding the stylus and for causing the feed-screw 13 to rotate at the proper speed to cause the stylus to move outwardly to keep it constantly over the strip. For this purpose I provide a fixed guide bar 14 that extends parallel with the feed-screw and I also provide driving mechanism 15 for driving the feed-screw 13 from a countershaft 16 that forms part of the mechanism 3 for driving the spindle 4. The strip 7 is formed of a magnetic metal but it should be understood that it is not magnetized.

The stylus 11 is also of a magnetic element, preferably soft steel or iron, which is capable of being magnetized and which is a good conductor for magnetic lines of force. The upper end of the stylus is secured in a carriage 17 that is guided at its upper end on the guide bar 14 and has a threaded opening 18 to enable it to ride on the threads of the feed-screw 13, being advanced by them when the feed-screw rotates.

Cooperating with the stylus 11 I provide electrical means controlled by the variations of magnetic forces developed in and around the stylus 11. For this purpose I provide an exciting coil 19 which is mounted in an exciting circuit 20 including a source of electromotive force such as a battery 21 and a variable resistance 22.

In addition to this, I provide a second coil 23, the current through which is to be varied by variations effected in the coil 19 and in the lines of force developed around the stylus 11. This coil 23 is connected in a talking circuit 24 which may include an amplifier A and a sound translating device, such as a loud speaker 25. If desired, the wiring of this circuit 24 may include batteries 26 and 27, as illustrated, or other sources of electromotive forces.

In order to facilitate the shifting of the carriage 17 along the feed-screw without necessi-

tating rotation of the screw, I provide the front of the carriage (see Figure 6), with a pivoted block or nut 28 mounted on a pin 29 and pressed against the side of the feed-screw by a small spring 30. By pressing up on the handle 31 this nut can be disengaged from the threads of the feed-screw and the carriage can then be swung back slightly so as to disengage it completely from the threads. Then it can be slipped longitudinally along the guide-rod 14.

Instead of constructing the record element 7 of a flat strip, as illustrated, I may employ a round wire element 32 (see Figure 4). This wire is bent into waves or undulation (see Figure 5) which correspond to the sounds to be reproduced. This wire is imbedded in the face of the body 33 of a disk record and cooperates with the stylus in the same way as the strip.

In the operation of the apparatus, as the record 6 rotates, the stylus 11 will be advanced by the feed-screw so as to maintain its point 12 directly over the metallic element and in close proximity to it.

The variations in the distance between the tip 12 and the metallic record element set up variations in the magnetic lines of force passing through the stylus and this affects the current flowing in the coil 19. These variations in current are amplified by the amplifier and translated into sounds by the loud speaker 25. The strength of the lines of force can be controlled by regulating the variable resistance 22.

My method of producing a record can be practiced very effectively with apparatus such as illustrated in Figure 7, the mechanism of which is somewhat similar to that illustrated in Figure 1. That is to say, it includes a turntable or platen 34 mounted for rotation on an instrument frame 35 supporting a horizontal guide-bar 36 and a parallel feed-screw 37. These parts 36, 37 correspond respectively to the bar 14 and the feed-screw 13 of the apparatus illustrated in Figure 1 and in the operation of the machine the feed-screw is driven at a certain definite ratio with respect to the rotation of the platen 34 as is customary in phonographs and similar instruments. On the upper face of the platen I mount centrally a record member in the form of a disk 38 of non-magnetic material. On the upper face of this disk the record is produced by means of the recording mechanism 39 which includes a slide block or carriage 40 guided on the rod 36 and similar in construction to the carriage or guide block 17 already described. In other words, in the operation of the machine the rotation of the feed-screw 37 moves the carriage 40 diametrically across the upper face of the platen 34. The lower portion of the carriage 40 carries a pickup device carrying an electric coil 41 mounted on a shell 42 of insulating material, said shell being mounted for rocking movement on a pair of pins, such as the pin 43. These two pins are located at diametrically opposite points on the shell 42.

The coil 41 is mounted between two armatures 44 carrying coils 45 which are excited by a battery 46 or other source of electromotive force connected by wires 47, 48, to the coils. The ends of the coil 41 are connected by wires 49, 50, into a circuit connecting up to an amplifier 51 of any suitable construction, the input side of the amplifier being connected by wires 52 to a sound translating device such as a transmitter 53.

The shell 42 of the rocking coil carries a vertically disposed stylus bar 54 the lower end of 150

which carries a stylus 55 in the form of a tubular pen tapering to a point 56 at its lower end and supplied with a recording liquid through a hose 57 leading over from a small reservoir 58 supported on the housing 59 for the pickup device. The recording fluid is of a magnetic character. For this purpose, I prefer to employ a magnetic ink; that is to say, a liquid carrying the usual liquid vehicle for ink but carrying finely divided iron in suspension. In the operation of the apparatus shown in Figure 7, while the record member 38 is rotating with the platen 34, the sounds to be recorded will produce variations through the amplifier 51 and through the circuit wires 49, 50, thereby producing variations in the current flowing in the coil 41, and these variations cause the coil to rock on the pivots 43 so that the point 56 of the stylus moves to and fro and produces a record line 60 on the upper face of the disk 38, said line being characterized by waves which correspond to the character or pitch of the sound received through the transmitter 53. The completed record will have a continuous spiral record line 60 (see Figure 11) passing around the center 61 of the record member like an ordinary phonograph record. A record of this character can be employed with the apparatus shown in Figure 1, so as to affect the coils 19, 23, and reproduce corresponding sounds at the translating device or loud speaker 25.

If desired, a record line corresponding to the record line 60 can be produced in which the waves are produced vertically instead of horizontally, corresponding to the "hill-and-dale" record already described. In order to do this, it is merely necessary to make the slight modifications in the apparatus illustrated in Figure 7, consisting in this, that the coil 62 of the pickup device 63 is mounted on horizontal pivot pins 64 which enable the coil to rock on a horizontal axis. In this type of recording the stylus bar 65 of the pickup device extends horizontally and carries a stylus 66 in the form of a tubular pen connected at its upper end by flexible connection 67 to the lower end of an ink reservoir 68. This coil 62 is connected up with wiring similar to that illustrated in Figure 7, to a transmitter 69 so that the sounds entering the transmitter produce variations in the coil circuit 70 thereby causing oscillation of the coil on its horizontal axis at the center of the pins 64.

This causes the tip 71 of the stylus to move up and down adjacent the upper face of the disk 72, and produces a record line 73 of the character illustrated in Figure 12, in which the variations are produced in width and thickness of the ink laid down on the face of the records. In other words the waves are disposed in a vertical plane, (see Figure 9), in which the variations in depth of this line is purposely exaggerated so as to illustrate the invention.

While the waves of this record line 73 are of increased width at the same points where they are of increased depth, this feature is beneficial because it increases the amount of iron at the deepest points, thereby increasing the effect of the passing wave on the reproducing circuit of the instrument illustrated in Figure 1.

In Figure 10 I illustrate the record disk 72 lying on a rotary platen 5', corresponding to the platen 5 of the instrument illustrated in Figure 1, and in this view the magnetic stem or stylus 11 is illustrated with its point in proximity to the record line 73.

It will be obvious that if desired my record can be produced on a record cylinder 74 instead of on a disc (see Figure 13), and in this case the cylinder to take the record would be mounted in apparatus such as commonly used for producing dictaphone records. That is to say, a machine of the same general character as the earliest type of phonographs, in which the record was carried on a wax cylinder. This cylinder 74 is in the form of a shell capable of being slipped over the drum of such an instrument and the instrument would be provided with the recording apparatus of the type illustrated in Figures 7 or 9.

Record lines embodying my invention can also be formed, if desired, on a continuous tape or film (see Figure 15), in which 75 represents a short portion of such a film. If desired, this film can carry a plurality of record lines alongside of each other. As illustrated, the film carries three record lines 76, 77 and 78 of markedly different character.

The record strip of the character shown in Figure 15 can readily be produced in an instrument of the type illustrated in Figure 14 in which the record film 75 is moved continuously past a recording stylus or pen 76 having the same character as the pens 55 and 66, already described, and controlled by a pickup device 77, said pickup device being connected in circuit with a transmitter 78 which receives sounds which affect the electric circuit 79 connected with the pickup device 77.

Where it is desired to reproduce records in large quantities from master records of the type illustrated in Figures 11 and 12, this may be accomplished by any of the well known methods for producing a printing plate having raised portions corresponding to the record line. For example, a master record of the type illustrated in Figure 11 could be electroplated so as to build up the record line after which impressions could be taken from the master record in soft wax from which electrotpe could be prepared in the usual manner.

In this way a printing plate 80 can be prepared from the original record and such printing plate can be employed to print on disks, such as the disk 81, of stiff cardboard or any other suitable material which could afterwards be laid on a rotary platen to cooperate with an instrument of the type illustrated in Figure 1.

The printing press illustrated in Figure 16 preferably includes a circular guide member 82 that accurately centers the printing plate 80 as it descends onto the platen 83 of the press, on which the record sheet 81 being printed is laid.

It is understood that the embodiment of the invention described herein is only one of the many embodiments this invention may take, and I do not wish to be limited in the practice of the invention, nor in the claims, to the particular embodiment set forth.

What I claim is:

1. The method of producing a magnetic record for reproducing sounds, which consists in supporting and driving a record member, depositing a liquid magnetic substance in a record line on the moving face of the record member and producing variations in the quantity of the deposits, to correspond with the sounds to be reproduced, in the record line while the same is being deposited on the record member.

2. The method of producing a magnetic record for reproducing sounds, which consists in supporting and driving a record member, de-

positing a liquid magnetic substance in a record line on the moving face of the record member, producing waves in which the quantity of the deposit is varied to correspond with the sounds to be reproduced in the record line while the same is being deposited on the record member, and permitting the magnetic liquid to dry. 5

3. The method of reproducing sounds, which consists in supporting and driving a record member, depositing a liquid magnetic substance in a record line on the moving face of the record member, producing waves varying the quantity of the deposit corresponding to the sounds to be reproduced, in the record line while the same is being deposited on the record member, permitting the liquid in the record line to dry to form a permanent record of the sounds to be reproduced, supporting and driving the said record member thereafter, producing variations in an electric circuit through the agency of the magnetic attraction of the waves in the record line, and translating the variations in the electric current into sounds. 80 85

VICTOR H. SEVERY.

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