July 24, 1934. J. H. HAMMOND, JR 1,967,882

PHOTO ELECTRIC SYSTEM FOR RECORDING AND REPRODUCING SOUND

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Fig. 1

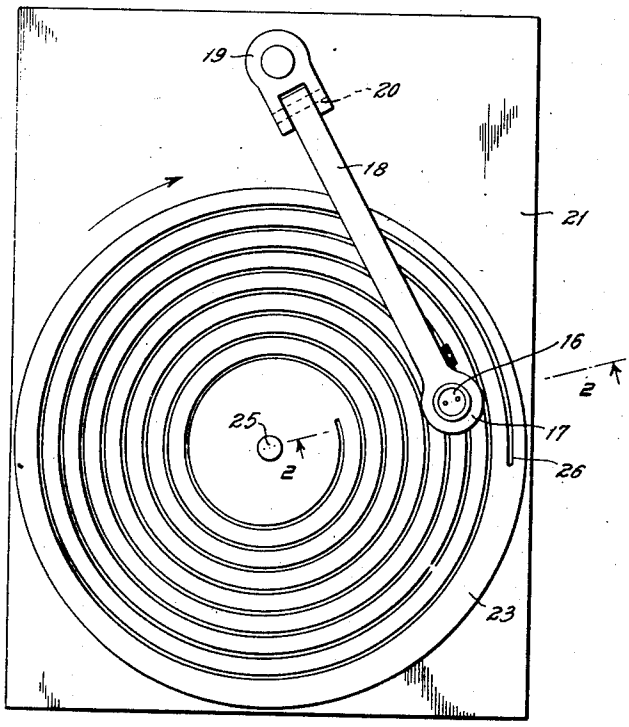

Fig. 2

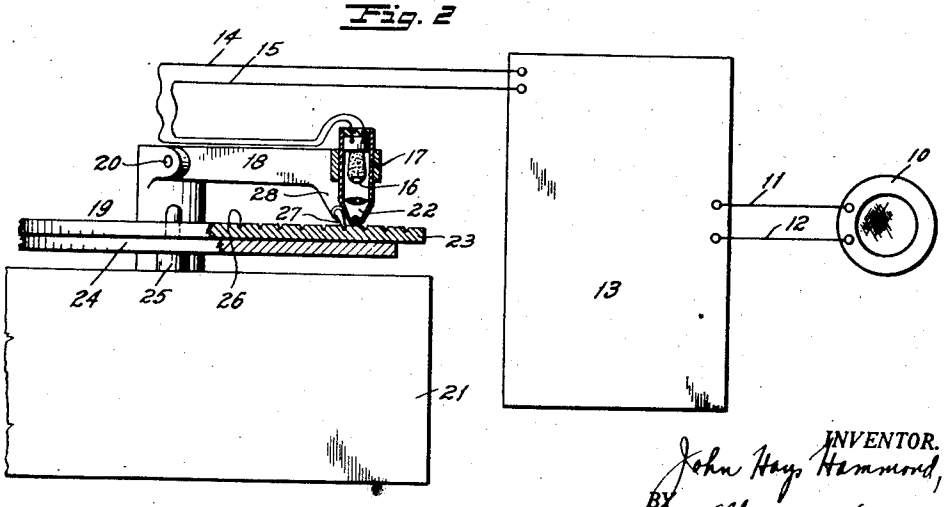

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Fig. 3

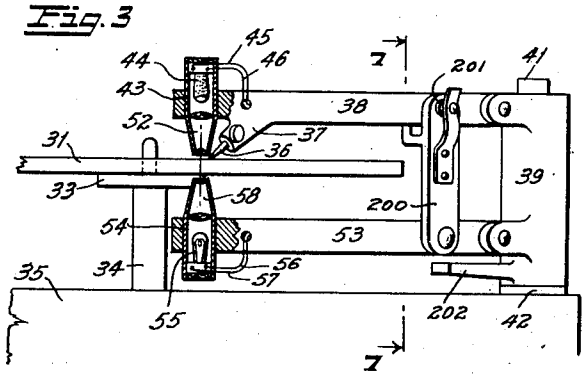


Fig. 4

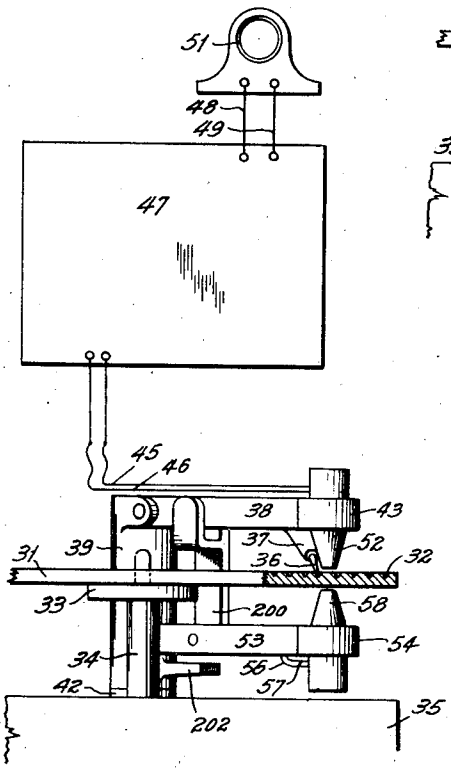


Fig. 5

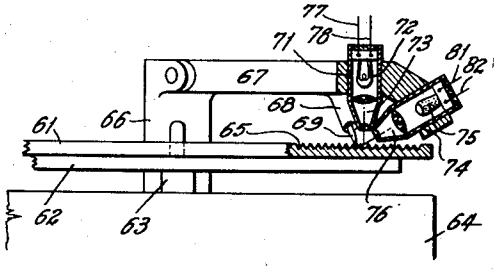


Fig. 6

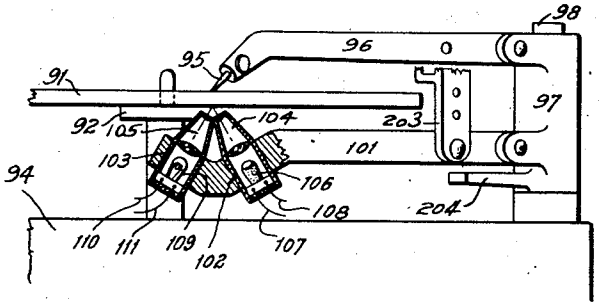
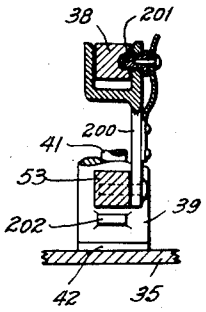


Fig. 7



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Patented July 24, 1934 1,967,882

UNITED STATES PATENT OFFICE

1,967,882

PHOTO-ELECTRIC SYSTEM FOR RECORDING AND REPRODUCING SOUND

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Application August 1, 1929, Serial No. 382,684

3 Claims. (Cl. 179—100.3)

The invention relates in general to the art of acoustics, and more particularly to phonographs.

A fundamental feature of the invention is to improve the sound characteristics of apparatus of the above type and to eliminate the objectionable needle scratch.

According to a preferred form of the invention a phonograph is provided in which the record discs have light-sensitive paths thereon which vary according to the sound selection and which has a photoelectric pick-up device for translating the light variations of the path into corresponding electrical variations. In addition, an acousto-mechanical device may be provided for translating the electrical variations into corresponding sound variations which are heard by the listeners. The invention may also be applied to recording.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, the mode of its operation and the manner of its organization may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which

Fig. 1 is a top plan view of one form of recording mechanism according to the invention.

Fig. 2 is an elevation partly in section of this mechanism.

Fig. 3 is a side elevation partly in section of one form of reproducing mechanism.

Fig. 4 is an elevation taken partly in section at right angles to the one shown in Fig. 3.

Fig. 5 is an elevation partly in section of a modified photoelectric system for reproducing the tones from an ordinary phonograph record.

Fig. 6 is a side elevation partly in section of another modified form of the invention.

Fig. 7 is a detail of a removable pin connection.

In the following description and in the claims parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Like reference characters denote like parts in the several figures of the drawings.

In the recording apparatus shown in Figs. 1 and 2, a microphone 10 is connected by two conductors 11 and 12 to an amplifier 13 which amplifies the music or speech picked up by the microphone 10 and transmits this amplified current over conductors 14 and 15 to a variable light source such as a neon tube 16, which is adjustably mounted frictionally, if desired, in a holder 17. This casing is supported in an arm 18 which is pivotally mounted by pivot 20 on a head 19, the head 19 being rotatably mounted on a casing 21. In the holder 17 is mounted a lens system 22 which focuses the light of the tube 16 onto a disc 23, which is carried by a turn-table 24. This turn-table is mounted on a drive shaft 25 which is rotated at a uniform speed by clockwork or an electric motor (not shown) mounted in the casing 21. The disc 23 is provided with a spiral groove 26 in which runs a needle or stylus 27 secured to an extension 28 of the arm 18. The surface of the disc 23 is covered with suitable light-sensitive photographic material.

In making the record, the microphone 10 is placed near the source of sound, and the motor in the casing 21 is started up so as to rotate the disc 23 at a uniform speed. As it does so, the needle 27 will travel in the spiral groove 26, causing the arm 18 to gradually swing toward the center of the disc. The current from the microphone 10 is amplified by the amplifier 13 and causes corresponding fluctuations in the light emitted by the neon tube 16. These fluctuations of illumination are recorded on the photographic material on the disc 23, this record forming a spiral path between the convolutions of groove 26.

The disc 23 may then be removed and developed, and from it may be printed any desired number of reproducing records 31 (Figs. 3 and 4). Each of these is provided with a spiral groove 32, which is similar in shape to the spiral groove 26. These reproducing discs may be made of transparent material such as celluloid composition or suitable kind of glass.

For reproducing the selection, disc 31 is then placed upon a turn-table 33 which is mounted on a drive shaft 34. This shaft is driven by a clockwork mechanism or an electric motor in a casing 35. Running in the groove 32 is a needle 36 which is mounted in an extension 37 of an arm 38. This arm is pivotally mounted to a head 39, this member being rotatably mounted on a shaft 41 which is carried by the casing 35. This shaft is provided with a shoulder 42 against which the head 39 rests. Carried by the arm 38 is a casing 43 in which is adjustably mounted, frictionally if desired, a photoelectric cell 44. This cell is connected by two conductors 45 and 46 to an amplifier

47. The output of this amplifier is fed over two conductors 48 and 49 to a loud speaker 51.

In the casing 43 is mounted a lens system 52 which focuses on the photoelectric cell 44. The head 39 is also provided with a lower arm 53 which carries a casing 54 in which is adjustably mounted a constant source of light such as a lamp 55 connected by conductors 56 and 57 to a source of electrical energy. Mounted in the end of the casing 54 is a lens system 58 which focuses the light from the lamp 55 on to the upper surface of the record disc 31.

The lower arm 53 is also pivoted to the head 39 and a link 200 is provided, which is pivoted to both the upper and lower arms providing, in effect, a pantograph action. The link 200 is permanently pivoted to the lower arm 53 and a spring pressed pin 201 is used for pivoting the link to the upper arm 38. When it is desired to place a record on the turntable 33 the pin 201 is disengaged which allows the upper arm 38 to be raised to allow plenty of room to install a record on the turn table. The stop 202 on the head 39 limits the downward movement of the lower arm 53 when the pin 201 is disengaged.

In the operation of the reproducing apparatus the motor in the casing 35 is started, thus rotating the disc 31 at a uniform speed. The needle 36 running in the groove 32 will cause the two arms 38 and 53 to be gradually moved toward the center of the disc. As they do so, the light from the lamp 55 will shine through the transparent record disc 31 and the record on the top of this disc thence through the lens system 52 and is focused on the photoelectric cell 44. The current from this cell is led over the conductors 45 and 46 to the amplifier 47 where it is amplified and fed over the conductors 48 and 49 to the loud speaker 51. In this way the variations of shading on the record disc 31 are translated to sound which is emitted by the loud speaker 51. By this means speech or music may be reproduced from the record without the scratch of the needle which it is impossible to eliminate in the ordinary phonograph, especially when electrical amplification is used.

In the form of the invention shown in Fig. 5, a record 61, which may be similar in construction to the standard phonograph record, is mounted on a turn-table 62 which is secured to a drive shaft 63 driven by a motor in the casing 64. The record 61 may be made in the usual way that a phonograph record is made and the grooves thereon are indicated at 65. Rotatably mounted on the casing 64 is the head 66 to which is pivoted an arm 67 with an extension 68 in which is mounted a needle 69 running in the groove 65. A casing 71 is carried by the end of the arm 67 and in it is adjustably mounted a constant source of light such as the lamp 72. The light from this lamp is focused by a lens system 73 on to one of the grooves 65. A second casing 74 is carried by the end of the arm 67 and in it is adjustably mounted a photoelectric cell 75 and a lens system 76 which focuses upon the cell 75. The lamp 72 is connected by two conductors 77 and 78 to a source of electrical energy and the photoelectric cell 75 is connected by two conductors 81 and 82 to an amplifier and loud speaker similar to that shown in Fig. 4.

In the operation of the form of the invention shown in Fig. 5 the motor in the casing 64 is started, thereby rotating the disc 61 at a uniform speed. The needle running in the groove 65 causes the arm 67 to gradually swing toward the center of the disc. As it does so, the light from the lamp 72 is focused, by means of the lens system 73, on to the spiral groove 65 and is reflected from the side of this groove to the photoelectric cell 75, the fluctuations in current from which are amplified by the amplifier and fed back to a loud speaker. The variations in the shape of the undulations of the grooves 65 will cause variations in the amount of light reflected to the photoelectric cell 75. This in turn will vary the current to the loud speaker, thus producing variations in tone corresponding to those impressed on the recording device when the record was made.

In case it is desired to provide a special groove for the needle 69 to run in, a second spiral groove may be used having smooth sides, which may run between the record grooves 65 and in which the needle 69 would run. In this case the lens system 76 would be focused on the groove next to the one in which the needle runs.

In the modified form of the invention shown in Fig. 6 a record disc 91 is mounted on a turntable 92 which may be rotated in the manner above described. The upper surface of the record disc may be provided with a spiral groove in which travels a needle 95 carried by an arm 96 which is pivoted to the head 97 which in turn is rotatably mounted on the shaft 98 carried by the casing 94. The head 97 is provided with a lower arm 101 which carries, at its end, two casings 102 and 103 which are provided with lens systems 104 and 105. Adjustably mounted in the casing 102 is a photo-electric cell 106 which is connected by two conductors 107 and 108, if sound reproduction is desired, to an amplifier and loud speaker similar to that shown in Fig. 4. Adjustably mounted in the casing 103 is a lamp 109 which is connected by two conductors 110 and 111 to a source of electric energy.

A link 203 with a removable pin (not shown) is used to connect the upper and lower arms in this case and a stop 204 is used, in the same manner as explained in connection with the arms of Figs. 3 and 4.

In the form of the invention illustrated by Fig. 6 the disc 91 may be made of any material such as that commonly used for phonograph records. In recording, the disc may be coated with light-sensitive, photographic material on the under surface. A variable intensity lamp may be used in place of the photoelectric cell 106 and be connected as shown in Fig. 2 to the amplifier which is operated from the microphone. The disc 91 is then run at a constant speed by the motor in the casing 94, and a record is made on the under surface of the disc by the fluctuating light which is focused by the lens system 104 on to the surface of the disc. This record is then developed and prints are made from it on the under surface of any number of discs, the upper surfaces of which are grooved to correspond with the spiral grooving of the disc 91. These reproducing discs 91 are then placed on the machine shown in Fig. 6, and are rotated at a uniform speed, the needle 95 running in the groove in the upper surface of the disc. This causes the arms 96 and 101 to swing in gradually toward the center of the disc. As they do so, the light from the lamp 109 is focused on the record on the under surface of this disc. The light reflected from this record will vary according to the shading of the record and will be focused by the lens system 104 on to the photoelectric cell 106. The fluctuating currents produced by this cell will be transmitted over

the conductors 107 and 108 where they will be amplified and fed to the loud speaker, thus reproducing the original voice or music.

The advantages of this latter system are that a closely spaced spiral groove may be provided on the top of the disc, thus allowing a closer spacing of the record spiral on the under surface of the disc and thereby making a smaller disc for the same length of record.

Thus it will be seen that a phonograph has been provided whose sound reproduction is independent of a needle or any similar device. The records having the light-sensitive paths thereon are relatively compact and are similar to the ordinary phonograph records and may be stored in a small space. At the same time improved acoustics are obtained because both in recording and reproducing the recorded selection is free from the action of a stylus. Although the invention has been explained in connection with disc records, it will be understood that other types of permanent records, such as the usual cylindrical record, may also be employed to carry out the invention.

While certain novel features of the invention have been shown and described and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes in the forms and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. In a phonographic system, a circular record disc having a spiral guide path, a spiral light-transmitting record path alongside said guide path, means for rotating said disc in the plane thereof, a source of light on one side of said disc, a photoelectric cell on the other side of said disc, said record path varying in opacity according to the recorded selection, arms on opposite sides of said disc holding said light source and photoelectric cell respectively in operative position, a guide member on one of said arms riding in said guide groove, means for holding said light source and photoelectric cell in alignment as said guide member moves said arms across the disc, and an electro-acoustic device fed by said photoelectric cell.

2. In a phonographic system, a circular record disc having a spiral record path on a first side of the disc, a spiral guide path accompanying said record path and located on the second side of the disc, means for rotating said disc in the plane thereof, a source of light and a photoelectric cell on said first side of said disc, said record path varying in light-transferring ability according to the recorded selection, first and second arms on opposite sides of said disc, said first arm holding said light source and photoelectric cell, a guide member on said second arm and riding in said guide groove, means for holding said light source and photoelectric cell in proper relation to said guide member as the latter moves said arms across the disc, and an electro-acoustic device fed by said photoelectric cell.

3. In a phonographic system, a circular record disc having a spiral guide path, a spiral photographic record path accompanying said guide path, means for rotating said disc in the plane thereof, a photoelectric device in light-transfer relation to said record path, a guide member riding in said spiral guide path, means for holding said photoelectric device in light-transfer relation to said record path as said guide member rides in said guide path when said disc is rotated, and an electro-acoustic device in energy-transfer relation to said photoelectric device.

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