Dec. 23, 1924. 1,520,357

H. C. LORD

METHOD OF AND APPARATUS FOR PRODUCING SOUND

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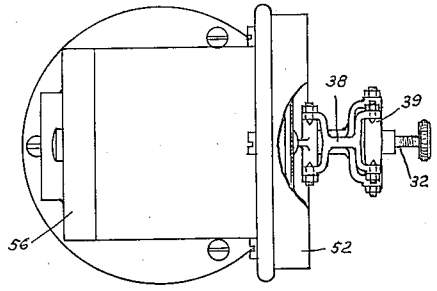


Fig. 4

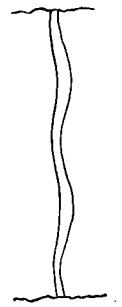


Fig. 6

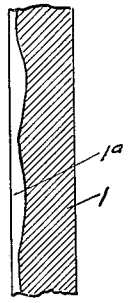


Fig. 7

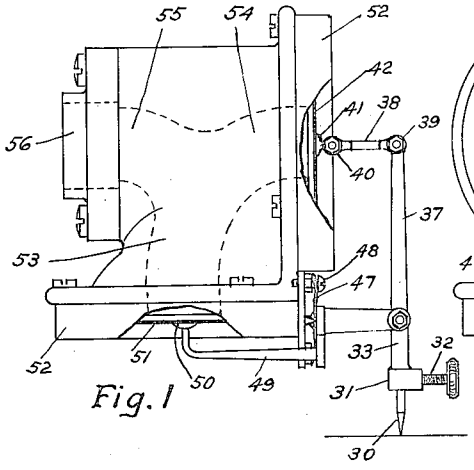


Fig. 1

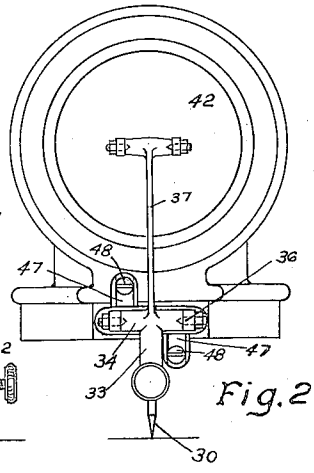


Fig. 2

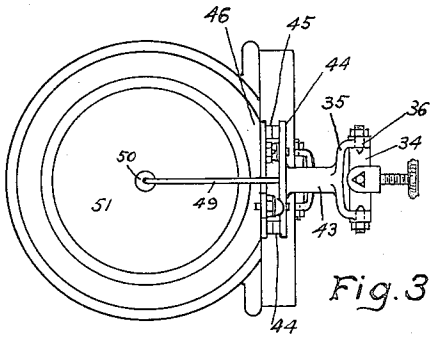


Fig. 3

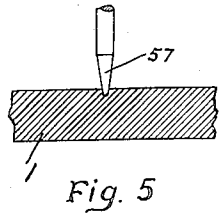


Fig. 5

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Fig. 8

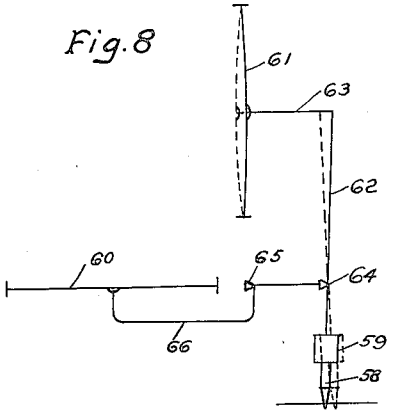


Fig. 9

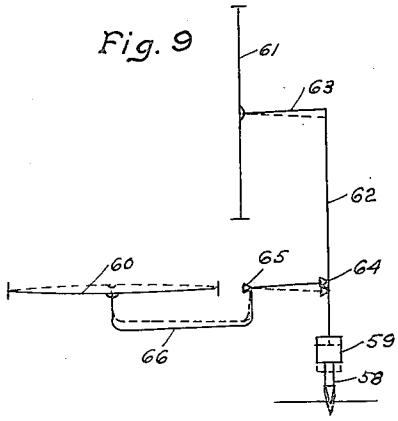


Fig. 10

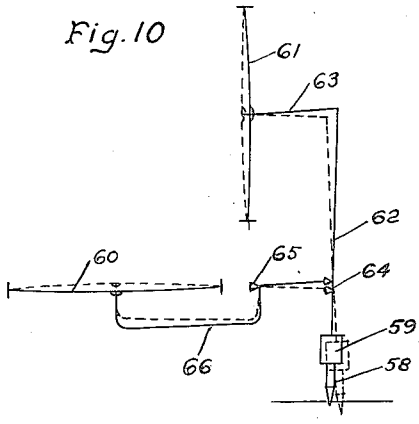
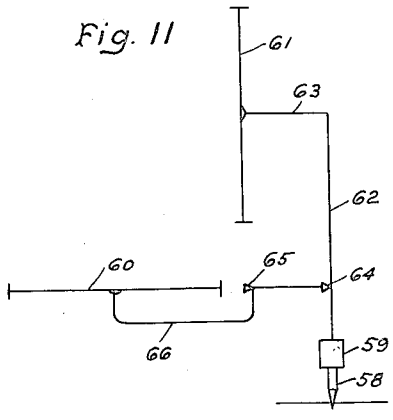


Fig. 11



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Fig.12

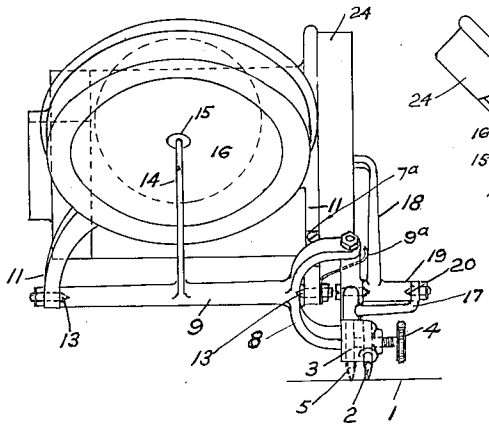


Fig.13

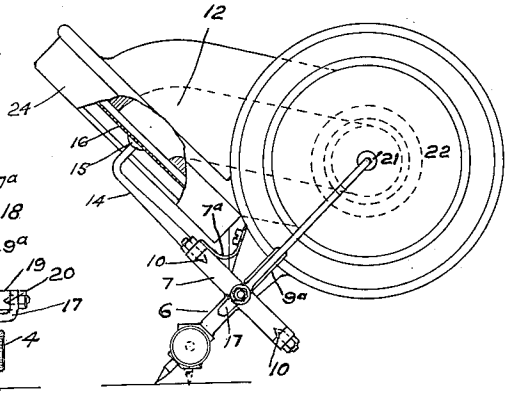
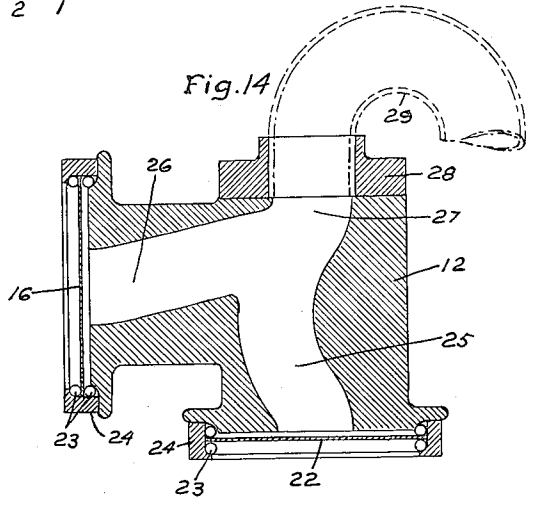


Fig.14



Inventor:
Hugh C. Lord

Patented Dec. 23, 1924. 1,520,357

UNITED STATES PATENT OFFICE.

HUGH C. LORD, OF ERIE, PENNSYLVANIA.

METHOD OF AND APPARATUS FOR PRODUCING SOUND.

Application filed July 2, 1920. Serial No. 393,545.

To all whom it may concern:

Be it known that I, HUGH C. LORD, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented new and useful Improvements in Methods of and Apparatus for Producing Sound, of which the following is a specification.

In carrying out this invention in the preferred form records are produced by impressing upon the record a sound groove having two distinct but synchronous series much in the way that multiple strings for the same notes accomplish this purpose in pianos and also as to such tones as may be responded to more particularly by one type of groove than the other of sound waves, one of the zig-zag type and the other of the hill and dale type. In producing this record sound receiving diaphragms are used each transmitting its vibrations to a single cutting tool and each diaphragm operating upon the tool independently of the other diaphragm. In this way the sound groove is perfectly formed so as to reproduce vibrations in two diaphragms, one from the side motions of a reproducing needle and the other from the vertical motions of such a reproducing needle. In this way the side walls of the groove may be utilized for producing vibrations and at the same time the bottom of the groove is utilized for producing synchronous vibrations in a second diaphragm. The result of this combination of vibrations and their translation into sound is to amplify the sound produced by a single needle and utilize all the working surface of the groove for this purpose. Not only this but in this manner slight errors that may occur in one of the sound producing series of waves may be corrected to a slight extent through the other series.

With a record so produced it is obvious that it can be utilized for reproducing sound with machines adapted to reproduce the records of the hill and dale type and also will be capable of reproducing sound with records operating on the zig-zag type. Further the apparatus for reproducing sound illustrated in this invention is, without any change in the position of the disk, capable of reproducing sound from either type of record. Where the zig-zag record is used the zig-zag waves are translated into vibrations of the diaphragm corresponding to these waves alone. On the other hand if the needle is operating on the hill and dale record motion is transmitted to the diaphragm corresponding to the vertical motion only. In this way a universal record is produced and a universal sound-producing apparatus provided.

An apparatus made in accordance with my invention and for carrying out the invention is illustrated as follows:—

Fig. 1 shows a side elevation of a sound box, partly in section.

Fig. 2 a side elevation of the same.

Fig. 3 a plan view from the bottom of the same.

Fig. 4 a top view of the same.

Fig. 5 a section of a record with a cutting tool in place thereon forming a groove therein.

Fig. 6 a plan view of a record showing an enlarged view of a record groove.

Fig. 7 a section of the same record showing the groove at corresponding points with the groove shown in Fig. 6.

Figs. 8, 9, 10 and 11 diagrams of a sound producing instrumentality and a record producing instrumentality.

Fig. 12 a front view of a sound box differing from that shown in Figs. 1 to 4 inclusive.

Fig. 13 a side elevation of the same.

Fig. 14 a central vertical section through the sound box.

1 marks the record, 2 the needle operating upon the record, 3 the needle carrier, 4 a screw for clamping the needle in the needle carrier, and 5 an alternative position of needle in a vertical position if such position is desirable, the same screw 4 operating to the vertical opening in which the needle 2 is arranged.

The needle carrier is mounted on an arm 6 which extends from a rock shaft 7. The rock shaft is mounted between the arms 8 carried by a rock shaft 9. Cone screws 10 extend into the ends of the rock shaft 7 forming a bearing permitting the oscillatory movement of the rock shaft in the arms 8. The rock shaft 9 is mounted between the arms 11 extending from the body 12 of the sound box and cone screws 13 extend through the arms 11 into the ends of the shaft 9 and form a pivotal

joint for the shaft 9. A vibrating finger 14 is secured at 15 to the hill and dale responding diaphragm 16.

An arm 17 extends laterally from the arm 6 to a position in alinement with the axis of the rock shaft 9. A rock shaft 19 is arranged between the end of the arm 17 and the shaft 7 and cone screws 20 extend into the ends of the shaft 19 forming a bearing permitting of the rocking of the shaft 19 relatively to the shaft 7. A vibrating finger 18 is secured at 21 to the zig zag responding diaphragm 22.

The diaphragms are secured between the rings 23 by means of a clamping ring 24 in the usual manner. A sound passage 25 leads from the diaphragm 22 and the sound passage 26 from the diaphragm 16, these passages being so arranged as to unite at a point equidistant from the diaphragms and to lead to one common sound passage. A fitting 28 is secured to the sound box and is positioned to continue the sound passage 27 and the usual supporting tubular arm forming the sound passage 29 extends into the fitting 28. Any flexible support may be provided for the arm 29. It, of course, must have a movement to follow the record and also must have sufficient movement to follow inequalities in the record.

If desired spring 7^a may be provided on the shaft 7 extending to the arms 8 so as to put tension on the diaphragm 22 and similarly a spring 9^a extending from the arm 11 to the arms 8 to put any tension desired on the diaphragm 16.

It will be noted that the fulcrum for the needle 2 when acted upon by the sides of the record groove to produce the zig zag vibrations for the diaphragm 22 is at the axis of the shaft 9 and the pressures exerted at this fulcrum should be in alinement with these pivots at least in the same direction as the axis of the shaft 9 and preferably in alinement therewith so that any zig zag vibration exerts no vibrating pressure upon the shaft 9 and consequently upon the hill and dale diaphragm 16. If, therefore, the sound box is used with a zig zag record vibrations are produced only in the diaphragm 22 and there is no interference with the sound produced through any disturbing action on the diaphragm 16. On the other hand if the needle is placed upon a hill and dale record the shaft 9 will lock in response to the up and down movement of the needle and the pivotal connection between the shaft 19 and the shaft 7 will prevent any movement being transmitted to the finger 18. Consequently with a needle operating on the hill and dale record the diaphragm 22 will remain mute so far as any direct sound producing vibration is concerned. On the other hand if a record having the combined qualities of sound waves is used each diaphragm will respond perfectly and completely to the record groove acting upon each diaphragm so that an error in one part of the groove will not effect the sound-producing quality of the other part of the groove on its particular diaphragm.

When it is desired to form a record utilizing the synchronized diaphragms communicating their movement to a single cutting tool a tool is mounted in the carrier in place of the needle and the diaphragms are mounted in sound receiving boxes of common type. The vibrations of the sound receiving diaphragms are communicated to the needle through mechanism similar to that described for the sound production, that is to say, the mechanism in which each diaphragm communicates its movement to the cutting tool independently but synchronously with its companion diaphragm.

In the alternative form shown in Figs. 1 to 4 the needle 30 is mounted in a carrier 31 secured by the screw 32. The carrier is mounted on an arm 33. The arm 33 extends from a shaft 34 which is mounted between the arms 35. Cone screws 36 extend into the end of the shaft 34 and form a joint. A vibrating finger 37 extends upwardly from the shaft 34 and is connected by a link 38 with a diaphragm 42, the link being pivotally connected at 39 with the finger 37 and pivotally connected at 40 with a securing button 41. The arms 35 extend from an arm 43. The arm 43 has a transverse plate 44 which is provided with pivotal knife-edges which operate in joint members 45 carried by the frame of the sound box 46. Springs 47 are secured to the plate 44 and are adjusted by screws 48. By means of these springs, one at each side of the plate 44, any resilient resistance to the movement of the arm 43 may be had as desired and these springs may be adjusted to carry part of the weight of the sound box and may be adjusted to put the proper tension on the diaphragm as desired.

It will be understood that joints of similar character may be used with the construction shown in Figs. 12, 13 and 14 if desired and also for other joints than this structure. A vibrating finger 49 extends from the plate 44 and is secured at 50 with the hill and dale responding diaphragm 51. The diaphragms 51 and 42 are secured in the usual manner by clamping rings 52 and the sound box is provided with the sound passages 53 and 54 leading from the diaphragms. These passages 53 and 54 leading to a common passage 55 are located in a direction to synchronize the sounds from the two diaphragms. A securing fitting 56 is provided in the usual manner.

In Fig. 5 I have shown a cutting tool 57. It will be understood that any cutting tool suitable for the shape of groove desired may

be used only a tool forming a bottom surface for the groove must be considered as well as the side walls. As before stated this tool is mounted in suitable mechanism connected with sound receiving diaphragms arranged to transmit the movement to the tool in the manner that the vibrations are transmitted to the diaphragms from the record.

In Figs. 6 and 7 enlarged views of sound grooves are illustrated, the groove being marked 1a. It will be noted that the grooves show a zig zag undulation as well as a hill and dale undulation and that these are synchronized. Ordinarily the groove will have the side walls so formed as to make the cutting tool readily clear and where this is the case the groove will show slight differences in the surface width.

In Fig. 8 I have shown diagrammatically the operation of the diaphragms when the sound box is placed upon a zig zag record. It will be noted that only the vertically arranged diaphragm is vibrated and the horizontal diaphragm is stationary.

In Fig. 9 the movement of the parts is shown with the needle operating on the hill and dale record. Here the vertical diaphragm is stationary and the horizontal diaphragm alone is vibrated.

In Fig. 10 is shown diagrammatically the double arrangement of diaphragms either for receiving or reproducing and here it will be noted that both diaphragms are vibrated synchronously and either from sound operating to receive sound or mechanically from the record for reproducing sound. In this diagram 58 indicates the needle or cutting tool as the case may be, 59 the carrier, 60 the hill and dale responding diaphragm, 61 the zig zag responding diaphragm, 62 a vibrating finger extending upwardly from the carrier 59, 63 a link connecting the finger 62 with the diaphragm 61, and 66 a horizontal arm pivotally mounted at 65 and pivotally connected to the vertical finger 62. In a general way this diaphragm follows the structure shown in Figs. 1 to 4 but outside of the reversal of the transmitting movement in the hill and diaphragm the diagram will illustrate the action of the structure shown in Figs. 12 to 14. It will be observed that with a record formed by this method there is a perfect hill and dale undulation to the groove so that the record will reproduce with machines adapted for such records and also that the record has the zig zag undulations so that the record will reproduce with the zig zag also. It will also be observed that these undulations are perfectly formed from independent sources and are not mere compromises of a movement produced from a single diaphragm. Consequently the reproduction quality of the record for both types of undulations is complete and perfect. Further it will be noted that the sound box will produce perfectly and completely from either type of record without any change in mounting of the sound box. It will further be noted that when the sound box is used with the record produced by the method here described there is a complete response from two diaphragms perfectly synchronized and that these diaphragms are actuated from different surfaces of the groove so that no added strain is put upon the record.

While the instrument here shown is particularly designed as a sound-producing instrument it will be understood that it will operate in actuating a groove forming tool to produce a record. Obviously the slight modification in sound receiving devices may be applied if desired and the instruments more completely adapted for this purpose. The underlying method of conveying movement to the common tool, however, would be utilized.

What I claim as new is:—

1. The method of reproducing sound comprising synchronously vibrating with the same tone waves a plurality of sound-producing elements from a single source of motion, each element responding to a different direction of motion at the source.

2. The method of reproducing sound which consists in synchronously vibrating with the same tone waves a plurality of sound-producing elements from a single source of motion, each element responding to a different direction of motion at the source, collecting the waves from the elements, and delivering the same through the same media.

3. In a sound box, the combination of two diaphragms set at an angle to each other; a vibrating finger operating on one diaphragm; a vibrating finger operating on the other diaphragm; connected pivotal mountings for said vibrating fingers; and a needle carrier carried by the mounting and delivering vibrations to one of the fingers in response to vertical vibrations and delivering vibrations to the other of said fingers in response to lateral vibrations.

4. In an apparatus for reproducing sound, the combination of two diaphragms; and a needle adapted to simultaneously engage both walls and the bottom of a sound groove and to transmit vertical undulations to one diaphragm and horizontal undulations to the other diaphragm simultaneously.

5. In an apparatus for reproducing sound, the combination of a sound record having record grooves therein with zig zag sound waves and hill and dale sound waves formed therein, the side walls of the zig zag groove forming the same sound waves; a needle simultaneously engaging both side walls and the bottom of the groove; a sound box having two diaphragms; and

means for conveying the vertical vibrations of the needle to one diaphragm and the horizontal vibrations of the needle to the other diaphragm.

6. In a sound producing apparatus, the combination of a sound box having two diaphragms, and means comprising a record and a single needle and mountings for the needle permitting it to synchronously vibrate in different directions in response to the record and to convey the said vibrations to the diaphragms, to produce on both diaphragms the same tone vibrations simultaneously.

7. In a graphophone, a pair of sound boxes arranged at right angles to one another, a stylus holder mounted for universal movement in proximity to the sound boxes, one-way flexible means between each sound box and said stylus holder and arranged to operate at right angles to each other, and a record tablet having a compound sound groove adapted to vibrate the stylus holder independently in planes at right angles to one another, whereby to transmit separate series of vibrations independently to the sound boxes.

In testimony whereof I have hereunto set my hand.

HUGH C. LORD.