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SOUND REPRODUCING SYSTEM

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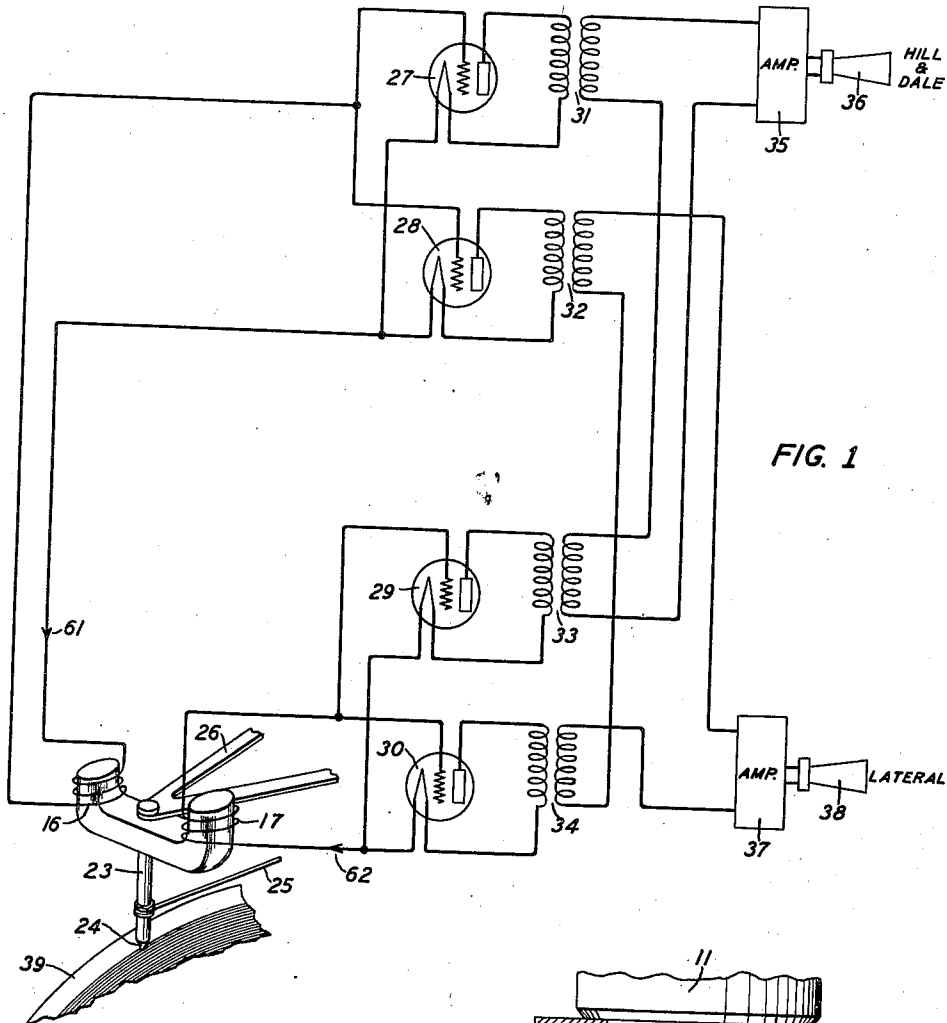


FIG. 1

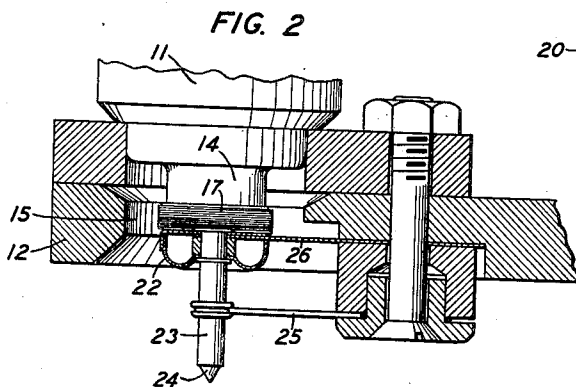


FIG. 2

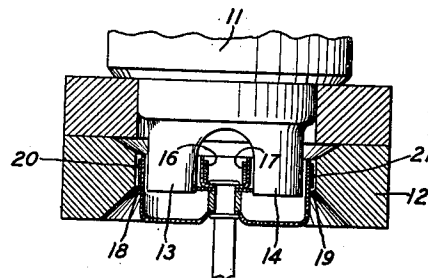


FIG. 3

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SOUND REPRODUCING SYSTEM

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8 Claims. (Cl. 179—100.4)

This invention relates to sound reproducing systems and the object of the invention is to obtain separate and simultaneous reproductions of two recordings in a single groove or sound track.

According to the invention the reproducing device has two generating elements each of which is connected to a divided circuit and each part of one circuit is combined with a part of the other circuit to form two reproducing channels for the two recordings. As applied to a disc phonograph system in which the records have both a vertical cut and a lateral cut recording in the same groove, the preferred embodiment of the invention comprises a double coil reproducer of the type disclosed in my copending application Serial No. 746,073 filed Sept. 29, 1934, and four vacuum tubes with individual output transformers. Each coil of the reproducer is connected to the input circuit of two of the tubes and the secondaries of the four transformers are connected in aiding and opposing pairs.

The vertical cut record vibrates both coils in the same direction and is, therefore, reproduced in the circuit associated with the aiding pair of transformers but the lateral cut record vibrates the coils in opposite directions and is therefore reproduced in the other circuit in which the transformers are in opposed relationship. In the first circuit, the lateral reproduction is balanced out and in the second circuit the vertical reproduction is balanced out so that simultaneous and separate reproductions of the two recordings are obtained.

The invention is particularly useful for reproducing music or other sounds with the space distribution of the original sounds since only a single record member is required and the playing time of the record is the same as that of an ordinary record of the same size.

The invention will be more clearly understood from the following detailed description and the accompanying drawing in which:

Fig. 1 is a circuit diagram of a reproducing system according to the invention, and Figs. 2 and 3 are sectional views of the moving system and associated portions of the magnetic circuit of a reproducer suitable for use in the system of Fig. 1.

The magnetic circuit of the reproducer comprises a permanent magnet, not shown, and pole pieces 11 and 12, the pole piece 11 having two end portions 13 and 14 projecting into the circular hole 15 in the pole piece 12 to form working gaps for the coils 16 and 17. The portions 13 and 14 and the pole piece 11 are of somewhat oval

cross-section and contoured to form short air-gaps 18 and 19 for the outer active sides 20, 21 of the coil. The coil supporting cup 22 is mounted on a tube 23 having a stylus 24 for engaging the record and this moving system assembly is supported by parallel springs 25 and 26. The lower spring 25 is free to deflect both vertically and laterally but the upper spring 26 is triangular in shape and hence relatively stiff in a lateral sense but free to deflect both vertically and torsionally. The coil 16 is connected to the input circuits of the vacuum tubes 27 and 28 and the coil 17 is similarly connected to the tubes 29 and 30. The output circuits of the tubes are connected to transformers 31 to 34, respectively, the secondaries of the transformers 31 and 34 being connected in aiding relationship to an amplifier 35 and a loud-speaking receiver 36, and the secondaries of transformers 32 and 34 being connected in opposed relationship to an amplifier 37 and a receiver 38.

When the reproducer is cooperating with a record 39 having both hill and dale and lateral undulations the stylus 24 will be vibrated simultaneously in both vertical and lateral modes. Assume the flux in the gaps 18 and 19 to be in the direction indicated by the arrows in Fig. 3, then for vertical vibrations of the stylus the coils will move vertically in the same direction and the potentials of the grid of tubes 27 to 30 will be varied in the same manner and the output potentials impressed on the primaries of the transformers 31 to 34 will all be in phase. Since the secondaries of transformers 31 and 33 are connected in aiding relationship, the sum of the potentials will be impressed on the amplifier 35 and the hill and dale recording will be reproduced by the receiver 36, but the equal potentials in the secondaries of transformers 32 and 34 will oppose each other so that no sound is heard from the receiver 38.

The lateral vibrations of the stylus imparted to it by the lateral recording will deflect the spring 26 torsionally and the coils 16 and 17 will vibrate vertically in opposite directions. Under this condition the variations in the potential of the grid of tubes 29 and 30 will always be 180 degrees out of phase with the variations in the potential of the grid of tubes 27 and 28. The potentials across the secondaries of transformers 31 and 33 will therefore oppose each other so that the lateral recording is not reproduced by the receiver 36. Similarly, the potentials across the secondaries of transformers 32 and 34 are opposed to each other but these windings are con-

nected in opposed relationship so that the sum of the potentials is applied to the amplifier 37 and the lateral recording is consequently reproduced by the receiver 38.

5 It will, therefore, be apparent that both the coils 16 and 17 are responsive to both modes of vibration of the stylus and that the separating circuit just described selects the "hill and dale" output of each coil and transmits it only to the receiver 36 and selects the "lateral" output of each coil and transmits it only to the receiver 38.

10 It will be understood that the two recordings in the grooves of the record 39 may be recordings of entirely unrelated sounds or of related sounds of any one of a number of kinds. For example, one recording might be a solo rendition and the other the accompaniment or the recordings may be related recordings of the same sounds for producing spacial distribution effects as taught by Rosenberg in British Patent 23,620 of 1911 or by Weir in Patent 1,508,432 granted September 16, 1924. When the system is used for producing spacial distribution effects, it will be understood that the receivers 36 and 38 should be suitably spaced as taught in the patents referred to above.

What is claimed is:

1. In a reproducing system the combination with a record combining in one track two independent recordings of the same sounds picked up at different positions, a reproducer having a stylus and two generating elements each responsive to both of the recordings and two reproducing circuits terminating in spaced loud-speaking receivers, of means for connecting each element to both circuits, and means in each circuit for balancing out the portion of the outputs of the elements from one of the recordings.

2. In a reproducing system the combination with a reproducer having two generating elements each responsive to vibrations in a plurality of modes and two transmitting circuits, of means for connecting each of the elements to each of the circuits, and means in each of the circuits for balancing out the output of the generating elements in one of the modes.

3. In a reproducing system a phonograph record having a hill and dale and a lateral recording in the same groove, a reproducer cooperating with the record and having two generating elements generating potentials of the same polarity representing the hill and dale recording and potentials of opposite polarity representing the lateral recording, two reproducing circuits, means for connecting each generating element to both circuits, means in one of the circuits for balancing out the potentials representing the hill and dale recording, and means in the other circuit for balancing out the potentials representing the lateral recording.

4. In a reproducing system a sound record hav-

ing in the same groove a hill and dale and a lateral recording of overlapping frequency bands, a reproducer cooperating with the record and having two generating elements each responsive to both recordings, a pair of reproducing circuits associated with the elements, means for excluding the reproduction of the hill and dale recording from one of the circuits, and means for excluding the reproduction of the lateral recording from the other circuit.

5. In a reproducing system the combination with a record having a groove containing two independent recordings including substantially the same range of frequencies undulating in different planes and a reproducer having two generating elements each responsive to both recordings, of two receiving circuits and means for connecting the elements in aiding relationship to one of the circuits and in opposed relationship to the other circuit.

6. In a reproducing system the combination with a record having a groove containing two independent recordings undulating in different planes and a reproducer having two generating coils each responsive to both recordings, of a receiving circuit including two mutually aiding windings, a receiving circuit including two mutually opposing windings, and means for impressing the output potential of each coil on one of the windings in each of the circuits.

7. In a sound reproducing system the combination with a reproducer having a stylus and two generating elements each responsive to vibrations of the stylus in different modes and two receivers for producing separate and simultaneous reproductions corresponding to the different modes of the vibrations of the stylus of a pair of transformers having their secondaries connected in aiding relationship to one receiver, a pair of transformers having their secondaries connected in opposing relationship to the other receiver, and means for connecting the primary winding of one transformer in each pair to each of the generating elements.

8. In a reproducing system the combination with a record combining in one track two independent recordings, a reproducer having a stylus and two generating elements each responsive to both of the recordings, and two reproducing circuits terminating in spaced loud-speaking receivers, of two vacuum tubes for each element having their input circuits connected to the element, a transformer for each tube having its primary winding connected to the output circuit of the tube and its secondary winding connected to one of the circuits, and connections in each circuit for balancing out the portion of the output of the element from one of the recordings.

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