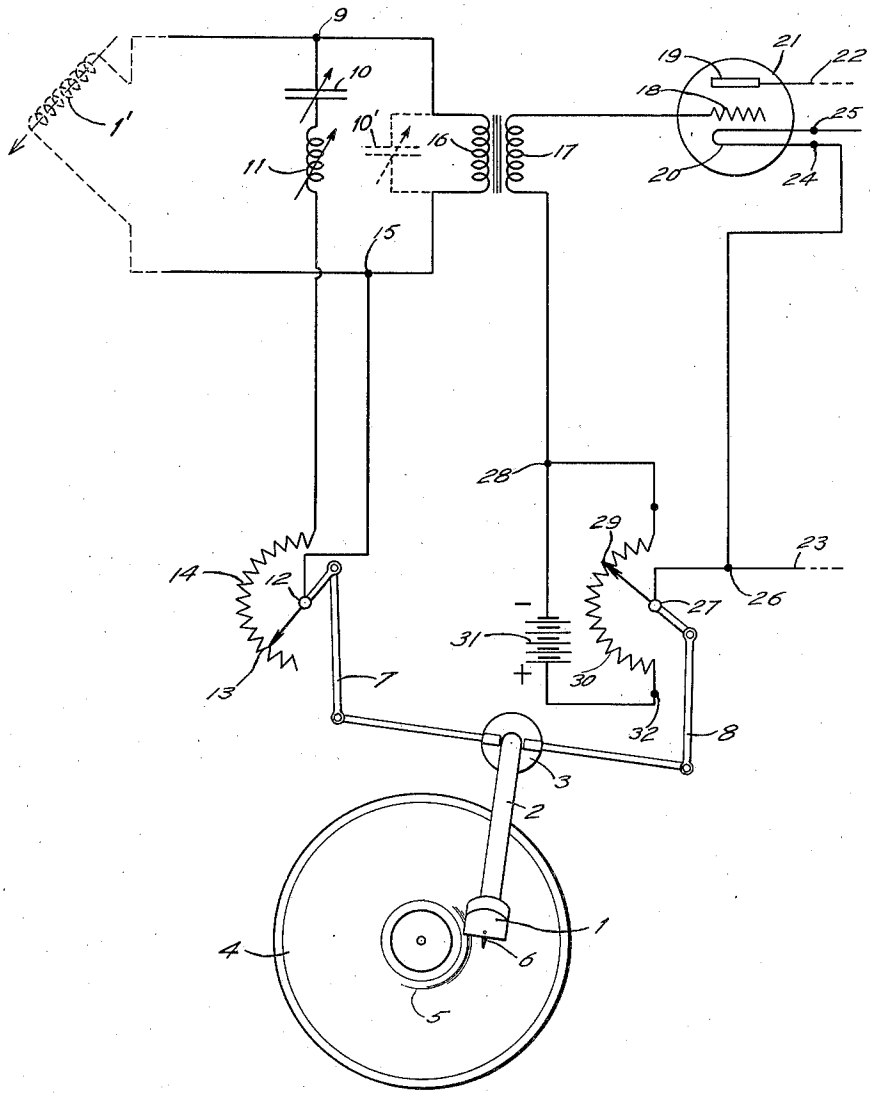
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PHONOGRAPH WITH AUTOMATICALLY COMPENSATED TONE AND VOLUME CONTROL

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PHONOGRAPH WITH AUTOMATICALLY COMPENSATED TONE AND VOLUME CONTROL

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This invention relates to phonographs, and particularly to high quality phonographs wherein the fidelity of reproduction is so high that the variations in reproduction characteristics of the record between the center and the periphery due to the difference in linear speed of the record groove become noticeable to the ear.

The invention involves the provision of automatically actuated tone and volume controls which co-act with the reproducing means to compensate for the variations in reproduction characteristic between the several portions of the record.

It is well known that the character of the reproduced music obtained from the usual forms of disc records varies depending upon the portion of the record being reproduced. The speed at which the needle of the pick-up is drawn through the groove (whether of the lateral or vertical cut variety) is greatest for the outside grooves and least for the inside grooves of a given record. As a result, everything else being equal, the reproduction of the higher audio frequencies will be less on the inner grooves of the record than on the outer grooves. In other words, the tone quality of reproduction, starting from the outside groove, will become progressively less "brilliant" or more "boomy" as the inner grooves are approached. If the reproduction is satisfactory at the beginning of the record, it is likely to fall short as the end of the record is approached.

In some cases the volume also drops off as the end of the record is approached.

It is the purpose of my invention automatically to compensate for either tonal changes, volume changes, or both, as the average radius of the record groove which is being reproduced is gradually diminished. Conversely, if the record is played from the inside groove out toward the outer grooves, my invention can be applied to compensate for tone quality and volume changes in the reverse sense.

One object of my invention is to provide means for automatically increasing the relative volume of reproduction of the central portion of a disc record to compensate for the usual falling off in volume due to decreased linear speed.

Another object of my invention is to provide means for automatically compensating for the loss of high frequencies at the central portion of the record in relation to the outer portion thereof.

Another object of my invention is to provide means for simultaneously compensating for the deficiencies in the volume and tone quality of the central portions of the record.

Another object of my invention is to provide means for controlling the operation of an amplifier to compensate for the variations in frequency and volume characteristics of a sound record.

Another object of my invention is to control the volume and/or frequency characteristics of the reproduction by the movement of the tone arm of a phonograph.

Referring now to the drawing:

At the upper left-hand portion of the figure, 1' represents diagrammatically the electrical connection of the magnetic pick-up mechanically indicated at 1 at the bottom of the figure. This pick-up, of course, may be of any electrical type, either electro-magnetic, a piezo-crystal, a condenser, or the like. The output of this pick-up is fed through a transformer 16, 17 to amplifier tube 21, and between the pick-up 1' and the transformer winding 16 are leads connected at the points 9 and 15, the latter leading directly to the terminal 12 of a variable resistance 14 which in turn is connected through the inductance 11 and the condenser 10 to the point 9. It will be apparent that this circuit composed of capacitance, inductance, and resistance can be adjusted by movement of the contact arm 13 to any desired point on the resistance to change the frequency characteristics of the input to the transformer winding 16. If, for example, the arm 13 is moved counter-clockwise until it is free from the resistance 14, the capacitance and inductance 10, 11 will have no effect, and the unmodified output of the pick-up will be transferred to the winding 16. As the contact arm 13 is moved and the portion of the resistance 14 in the circuit is decreased, certain frequencies will be by-passed through the condenser 10, the inductance 11, and the resistance 14 until at the extreme clockwise position of the arm, there will be no resistance in circuit and the frequencies by-passed will be determined entirely by the characteristics of the condenser and inductance.

The output from the transformer 17 is fed to the grid 18 of the tube 21, and the other side of this transformer is connected at 28 to a variable resistance 30 which is connected across the C battery 31 as a potentiometer. The terminal 27 of the contact arm 29 is connected at 24 and 26 to the circuit of the cathode 20 of the tube 21. It will be apparent that movement of the contact arm 29 over the potentiometer 30 will vary the grid bias on the tube 21 and will, therefore, vary its amplification. The heater circuit and subsequent portions of the plate circuit 22 of the tube 21 are, as usual, not shown.

The tone arm 2 which supports the pick-up 1 is rigidly connected to the plate 3 having lateral extensions pivoted to the links 7 and 8, and these links in turn are connected to the movable arms 13 and 29 of the two resistances. It will be apparent that as the needle 6 is moved over a phonograph record 5 in one direction or the other, due to the rotation of the turntable 4, the arms 13 and 29 will be correspondingly shifted in position.

In the specific arrangement shown, when the needle 6 is on the outside edge of the record 5, the arm 13 will be in its most clockwise position, while the arm 29 will be in its most counter-clockwise position. Correspondingly, a maximum of the high frequencies from the record will be by-passed through the capacitance 10 and inductance 11, while the grid bias provided by the potentiometer 30 will be at a minimum. As the record rotates and the needle 6 moves toward the center of the record where high frequencies are less predominant and the amplitude is less, the arm 13 will move toward the position shown, thereby increasing the resistance in series with the elements 10 and 11 and decreasing the amount of high frequencies by-passed. At the same time, the arm 29 will approach the position shown, thereby increasing the negative bias on the grid 18, and increasing the amplification provided by the tube 21.

It will be apparent that this arrangement will thus compensate for a decrease in the high frequencies, and a decrease in the effective amplitude of the record near to the center.

The values of the resistances 14 and 30 may be chosen for any specific type of record, or they may be made adjustable to compensate for different types of records. Likewise, the range of movement of the arms 13 and 29 may be adjustable by shifting the position of one or both of the pivots of the links 7 and 8.

The capacitance 10 and the inductance 11 may be made adjustable, as indicated in the drawing, and either or both may be connected to the link 7 in addition to, or instead of, the resistor 14. Alternatively, a variable capacitance, as indicated in dotted lines at 10′ shunted across the winding 16 of the transformer, may in some cases be substituted for the capacitance 10, the inductance 11, and resistance 14, and may be connected to the link 7. If the capacitance 10 and the inductance 11 are connected to the link 7 in place of the resistor 14, their effect will depend on the natural frequency of the combination of the capacitance 10 and the inductance 11. If this natural frequency is a low frequency, the capacitance 10 and the inductance 11 will act as a low-frequency by-pass across the primary transformer winding 16 with the resulting enhanced amplification of the higher frequencies. This would be appropriate for playing the central portion of the record. As the outer portion of the record is played, the capacitance 10 and the inductance 11 might be tuned to a higher frequency, thus relatively reducing the high-frequency response. The resistor 14 may be inserted to control the decrement of the combination including the capacitance 10, the inductance 11 and the resistor 14, thus giving a broader-band effect of selective absorption. The capacitance 10′ will produce the effect, in general, of by-passing high frequencies and therefore should be held at a maximum by the link 7 when thus used for the outer portions of the record groove.

The tube 21 is, of course, not limited to a conventional triode as illustrated, but may be any suitable type of tube useful as an amplifier of audio frequency currents. For example, in the circuit shown, I may use one of the customary super-control type of tetrode, such as the RCA Type—35 which can be used with no modification of this circuit, or I may use a tube of the tetrode or pentode type wherein control of the potential on a grid other than the control grid governs the amplification, in which case the transformer winding 17 would be connected to the control grid, and the potentiometer 30 would be connected to the amplification control grid.

It will be apparent that my invention is not limited to the use of the combined frequency and volume control, but that I may use either independently of the other. It will also be apparent that my invention is not limited to the application of either the frequency or the volume control to the specific portions of the circuit indicated in the drawing, but that either of them may be applied to any suitable portion of the circuit from the input at 1′ to the output which may be a loudspeaker, re-recording device, or the like.

Having now described my invention, I claim:

1. In combination, a phonograph including a driving motor, an amplifier, and means operable independently of the operation of said motor for varying the amplification produced by said amplifier in accordance with the position of the tone arm of the phonograph.

2. In combination, a phonograph including a driving motor, an amplifier, and means operable independently of the operation of said motor for varying the frequency characteristic of the input to said amplifier from said phonograph in accordance with the position of the tone arm of the phonograph.

3. In combination, a phonograph of the disc type having a movable tone arm, and means connected to said tone arm for varying the characteristics of the output of said phonograph in accordance with the position of the tone arm.

4. A phonograph of the disc type having a tone arm, a variable resistance for varying the characteristics of the output of said phonograph, and means connecting said variable resistance and said tone arm.

5. In combination, a phonograph including a driving motor, an electrical pick-up, an amplifier circuit, means operable independently of the operation of said motor for varying the frequency characteristic of the input to said amplifier from said pick-up in accordance with the position of the pick-up in relation to a record, and means also operable independently of the operation of said motor for varying the amplification of said amplifier in accordance with said position.

6. The method of reproducing sound from a motor driven phonograph record with the aid of a record scanning element which comprises the steps of correcting the frequency characteristic of the record and simultaneously varying the volume to compensate for the frequency correction, both as functions solely of the position of said scanning element on the record and independently of the operation of the motor.

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