

PATENT SPECIFICATION

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- (21) Application No. 13073/72 (22) Filed 21 March 1972
 (31) Convention Application No. 126 678 (32) Filed 22 March 1971 in
 (33) United States of America (US)
 (44) Complete Specification published 30 April 1975
 (51) INT. CL.³ G11B 9/00 25/04/11/02 3/72 9/06
 H04N 5/76
 (52) Index at acceptance
 G5R B205 B211 B251 B25Y B261 B262 B263 B283 B333
 B340 B341 B34Y B361 B36Y B445 B581 B584
 B58Y B60X B611 B612 B61X B61Y B623 B694
 B701 B721 B737 B789



(54) HIGH DENSITY INFORMATION RECORDS AND PLAYBACK APPARATUS THEREFOR

(71) We, RCA CORPORATION, a corporation organized under the laws of the State of Delaware, United States of America, of 30 Rockefeller Plaza, City and State of New York, 10020, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates generally to high-density information record playback systems and apparatus therefor, and, particularly, to such articles in novel forms providing for co-operative establishment and employment of capacitance variation effects, and readily permitting, for example, relatively inexpensive mass replication and relatively simple playback of video signal recordings of appreciable playing time.

The recovery of recorded information, by use of capacitance variations established through cooperation of a recording with a pickup electrode of associated playback apparatus, has been proposed in the past for low-density recordings, as exemplified by the disclosures of the following U.S. patents relating to sound recording systems: 1,580,112; 1,715,863; 1,859,551; 1,891,780; 2,373,273; and 2,442,140.

The present invention recognizes that such cooperative capacitance varying phenomena may be used to advantage to achieve a high-density information record and playback system, whereby, for example, a video signal recording of appreciable playing time may be realized in a relatively inexpensive form subject to relatively simple playback techniques.

In accordance with the invention, a video or other high density information signal recording takes the form of a spirally grooved disc subject to playback by apparatus employing a pickup stylus riding in

the disc groove. The groove has a constant width and contains an information track constituted by geometry variations in the bottom of the groove representative of recorded information. The instantaneous location of the center of the groove is not varied in accordance with recorded information; rather, the center-to-center spacing of successive convolutions of the spiral is substantially constant and independent of the recorded information, whereby close spacing of the successive convolutions may be achieved. The groove sidewalls have a configuration which is substantially constant throughout said successive convolutions and independent of the groove bottom geometry variations representative of recorded information. A stylus having a tip receivable in the disc groove during playback includes a support element of insulating material and an electrode of conductive material supported thereby, this electrode presenting a surface to the disc groove bottom when the tip is received in the disc groove. During playback, rotational relative motion is effected between the disc and the stylus (e.g. by rotation of a disc-supporting turntable) with the stylus tip received in and travelling along the groove. Electrically connected to said stylus electrode are appropriate means for developing an electrical signal representative of groove bottom geometry variations passing the said stylus electrode surface during such relative motion. These variations do not mechanically affect the stylus but rather serve to vary capacitance presented between the stylus electrode and, for example a conductive surface of a disc supporting turntable.

This electrical circuitry incorporating the varying capacitance can serve to translate the capacitance variations occurring during playback into electrical signal variations which may be suitably employed to effect

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visual display of the recorded information. Illustratively, the electrical circuitry may comprise a resonant circuit which incorporates the varying capacitance, and to which are applied oscillations (at a frequency suitably higher than the recorded signal frequencies) so that a signal representative of the recorded information can be obtained by detecting the resulting variations in the response of the resonant circuit to such oscillations.

Pursuant to the concept of the present invention, the pickup stylus desirably comprises a stylus tip having insulating sidewalls for disc groove sidewall engagement, said insulating side walls being provided by a support element of insulating material; and a conductive electrode supported by said support element and having a surface positioned so as to be presented towards the disc groove bottom when the stylus tip is received in the groove, this stylus electrode preferably having a lateral dimension, in a direction extending between said insulating sidewalls, which is less than the distance between said insulating sidewalls whereby to preclude disc groove sidewall engagement of said conductive electrode, and the said surface of the stylus electrode preferably having a dimension in the direction extending between the stylus sidewalls which is substantially greater than the transverse dimension of said surface, this latter dimension being, for example, no greater than 1 micrometer.

The disc can be of a thermoplastic material, such as vinyl (as used in audio phonograph records), whereby the grooving of such material and the formation of the dimension-varying information track therein may be effected by mass replication techniques akin to the record stamping operations associated with the audio phonograph record industry.

An illustrative dimension variation pattern, that may be employed to vary the geometry of the groove bottom, is the relative raising and/or depression of the thermoplastic material in the groove bottom in accordance with the recorded information. With the dielectric constant of the thermoplastic disc material greater than that of air, the capacitance presented during playback between the stylus electrode surface and, say, a conductive surface on the turntable will be greater when the stylus electrode surface is positioned over a relatively raised area in the groove bottom than when the stylus electrode surface is positioned over a relatively depressed area. Thus, as relative motion between the groove and stylus occurs, the successive alignments of the stylus electrode with differently raised and/or lowered regions in

the groove results in a succession of capacitance variations representative of the recorded information.

The invention and its advantages may be more fully understood by those skilled in the art upon a reading of the following detailed description and an inspection of the accompanying drawings, in which:

FIGURE 1 is a transverse sectional view fragment of a disc record, showing the engagement during playback thereof of a stylus tip with the walls of a disc groove containing an information track in the groove bottom, and illustrating an application of the principles of the present invention;

FIGURE 2 is a longitudinal sectional view of the record groove of FIGURE 1, with a further view of the stylus tip in playback engagement therewith;

FIGURE 3 is a top view of illustrative playback apparatus that may be employed in association with the stylus and disc record of FIGURE 1 and 2 pursuant to the principles of the present invention; and

FIGURE 4 is a diagram, partially in schematic and partially in block form, depicting illustrative electrical circuitry that may be employed to process capacitance variations occurring with relative motion between stylus and groove during operation of the FIGURE 3 apparatus pursuant to the principles of the present invention.

Claims directed to the disc record *per se* are presented in application No. 49430/74 (Serial No. 1 392 204) divided therefrom.

Referring to FIGURE 1, the pickup stylus 10 includes a body of insulating material which provides the tip of the stylus with insulating side walls for engagement with the side wall of the groove, and a conductive electrode 20 accommodated in the insulating body and having a surface exposed at the end of the stylus tip. The stylus tip rides in a groove 15 in a recording medium 30 constituted by a spirally grooved disc illustrated fragmentarily. The relative motion of the groove 15 with respect to the stylus 10 during playback is perpendicular to the plane of FIGURE 1. It is seen that the stylus tip is supported by the side walls 12 and 14 of the groove 15; lands 50 and 60, respectively, form the boundaries for the illustrated groove segment, separating it from adjacent groove convolutions. Electrode 20 is aligned to be centered above an information track 75 in the bottom of the groove 15.

Pursuant to an illustrative example of groove bottom geometry modification, the information track 75 may comprise variations in the height of the groove bottom along the length of the groove 15 (as best shown in the longitudinal sectional view of

FIGURE 2) with the consequence of complementary variations in the magnitude of an air gap 40 between the electrode 20 and the track 75. The illustrated width of the electrode 20 (FIGURE 1) is substantially coincident with the width of the information track 75 in the groove 15. The thickness (FIGURE 2) of the electrode 20 at the exposed tip is of a still smaller magnitude appropriate to resolution of the smallest required information track variation.

As FIGURE 2 shows, the stylus 10 is supported by the groove side walls in such manner that passage of the elements of information track 75 beneath the tip of stylus 10 will desirably impart no mechanical disturbance to the stylus. What will occur, however, during such passage of the track elements, that may be utilized in recorded information recovery, is a variation in the capacitance presented between the electrode 20 and a reference conductive area, positioned, for example, beneath the disc. 30. Illustratively, the reference conductor may comprise a conductive surface of a turntable provided to support and rotate disc 30.

Illustrative dimensions for the stylus electrode 20 and the spiral disc groove 15 are the following: electrode 20 width-5 micrometers; electrode 20 thicknesses-1 micrometer; groove pitch equivalent to 2000 grooves per inch. Associating such dimensions with an illustrative disc rotation speed of 600 rpm, one may obtain, for example, recovery of signal frequencies up to about 4 megacycles, with a one-side playing time of approximately 10 minutes, from a 12 1/2 inch diameter disc having the highest frequency variation occupying 2.5 micrometers of groove length per variation wavelength.

Other parameter combination may, of course, be employed, where, for example, a lower disc rotation speed is desired.

In copending application no. 13075/72 (Serial No. 1 392 202) modifications and improvements of the herein described record and playback arrangements are described in detail. Reference may also be made to application no. 48664/74 (Serial No. 1 392 203) divided from that application for example of record cutting techniques that may be adapted to development of a stamping master suitable for mass replication of the disc 30; see, particularly, the master preparation process described in the above-noted application no. 48664/74 (Serial No. 1 392 203) and the description of scanning electron microscope processes for recording of groove bottom information tracks. Reference may be made to application 13075/72 (Serial No. 1 392 202) for an example of

procedures that may be followed in forming stylus 10.

FIGURE 3 is a top view of record player mechanism which may, illustratively, be employed in playback of the disc 30 of FIGURES 1 and 2. The mechanism includes a turntable mounting board 102 which has a drive motor and drive mechanism (not shown) for rotating a disc-supporting turntable 31 (only partially shown). A shield enclosure 104 includes a stylus arm 106, which rests on a stylus arm centering bracket 107 when the machine is not operating. The stylus 10 is attached to the stylus arm 106 by means of a stylus mounting cap 108. An aperture 109 in shield enclosure 104 permits stylus 10 to pass through the enclosure and contact disc 30. The electrical connection to the electrode imbedded in the stylus is made by means of a flexible conductor 110, which may be fabricated from beryllium copper, for example. The stylus arm 106 is attached to a groove velocity error drive mechanism 125 by means of a flexible pivot assembly 120 which allows the stylus arm 106 to move in a lateral as well as vertical direction during operation. The flexible pivot assembly 120 may be as described in detail in the aforementioned application 13075/72 (Serial No. 1 392 202).

The shield enclosure 104 and stylus arm 106 are driven to allow the stylus 10 to track the groove 15 by means of a drive shaft 130 which is engaged by an engaging mechanism 135 coupled to the shield enclosure 104 by means of a shield enclosure bracket 136. The drive shaft 130 may be coupled to the drive mechanism in the manner described in detail in application 13075/72 (Serial No. 1 392 202).

In operation, the shield enclosure 104 including the stylus arm 106 is moved across the record by means of the drive shaft 130 to provide tracking with the groove 15. The flexible pivot 120 as well as the flexible conductor 110 allows the stylus arm 106 to float on the disc 30, thereby permitting the stylus 10 to track surface deviations in the disc such as warping. The groove velocity error drive mechanism 125 is driven by signals from the circuitry shown in FIGURE 4 (to be subsequently described) to compensate for velocity errors due to turntable speed variations, record eccentricity, or other velocity errors. The operation of the mechanism 125 is described in detail in copending application No. 13074/72 (Serial No. 1 383 336). It is noted that the stylus arm 106, the shield enclosure 104, and the drive mechanism 130-136 can be replaced in some applications with a relatively long lightweight pickup arm which can pivot on the turn-

table base in much the same manner as an audio record player pickup arm.

The shield enclosure 104 may also house some of the electrical circuits of FIGURE 4. For example, an inductor 145, to which the stylus electrode 20 is coupled, can be mounted on a circuit board 140. Other circuit components can be mounted on circuit board 140 without affecting the tracking weight of the stylus 10, since the stylus arm 106 is free floating and independent of the shield enclosure 104. A typical tracking weight on the stylus is less than one gram.

FIGURE 4 is a schematic circuit diagram, partially in block form, of illustrative electrical circuitry that may be employed to process the capacitance variations, occurring between the electrode 20 and a reference conductor during playback of disc 30, to produce useful output signals. The circuit may be used, for example, to provide an amplitude modulated carrier signal which is applied to the antenna terminals of a television receiver for producing a television display.

In FIGURE 4, variable capacitor 200 represents the capacitance between the stylus electrode 20 and the reference conductor (illustratively, the conductive turntable 31 suitable grounded) during playback of disc 30. The electrode 20 is coupled to an inductor 145 by means of the electrical conductor 110 (also shown in FIGURE 3). A peak detector circuit 155 is coupled to a tap 149 on inductor 145. Circuit 155 comprises a diode 157, and the parallel combination of a resistor 156 and a capacitor 158 coupled between a terminal on the diode (remote from its connection to inductor 145) and ground. Capacitor 158, shown as a lumped parameter, may simply comprise the sum of the stray capacitance of the leads and the input capacitance of the pre-amplifier 160. A second tap 147 on inductor 145 is coupled to ground and thereby to the reference conductor.

An RF oscillator 150 applies radio frequency signals to inductor 145. A pre-amplifier 160 is coupled to the peak detector circuit 155 and provides amplified video signals at its output.

Circuit elements 145, 155 and 160 may be mounted in the shield enclosure 104, advantageously placing the components in proximity with the pickup electrode in order to reduce stray reactances. This is indicated in the drawing by the dashed lines surrounding these circuit components. The output of pre-amplifier 160 is coupled to an amplifier 170 which further amplifies the detected signals. The output of amplifier 170 is coupled to an A.M. modulator 180 and to a sync separator circuit 190. The output of the sync separator circuit 190 is coupled to a discriminator circuit 210. The

output of the discriminator circuit 210 is coupled to the groove velocity correction circuit 125 shown in FIGURE 3. An oscillator circuit 220 produces a carrier signal which is applied to the A.M. modulator 180, and is modulated by the signal information from amplifier 170. The amplitude modulated carrier from modulator circuit 180 may be applied, for example, to the antenna terminals of a television receiver.

In operation, the RF oscillator 150 provides an excitation voltage to a resonant circuit which comprises the capacitor 200, the inductor 145, the junction capacitance of diode 157 and the stray capacitance 158. The inductor segment between the RF oscillator 150 and terminal 147 operates as an auto-transformer to couple the RF excitation signal to the resonant circuit. As the resonant frequency of the circuit is varied due to variations of capacitance 200, the amplitude of the excitation voltage at the input of the diode varies. The Q of the resonant circuit is chosen to yield a sufficiently sharp voltage versus frequency curve to provide adequate signal amplitude variations at tap 149 of inductor 145 for detection by peak detector 155. The Q should be chosen, however, such that the resonant circuit simultaneously exhibits adequate bandwidth. The frequency of oscillator 150 is desirably chosen such that it falls on one side of the frequency response curve of the resonant circuit and, as the resonance frequency of the resonant circuit changes due to signal information, will remain on that slope of the shifting frequency response of the resonant circuit during all signal conditions. As the element 20 tracks in groove 15, capacitance 200 varies in accordance with the recorded information. The varying capacitance shifts the resonant frequency of the tuned circuit. Since a constant frequency bias signal (from oscillator 150) is being applied to the circuit, as the resonant frequency varies, the response of the circuit to the bias frequency changes as a function of the recorded information, thereby providing an amplitude modulated output signal at terminal 149. Peak detector 155 detects these amplitude variations by means of diode 157, and the filter network comprising capacitor 158 removes the frequency components above the frequency of the signal information.

The signals from detector 155 are coupled to preamplifier 160 which may also be mounted in the shield enclosure 104 to reduce noise interference with the signal. The output signal from amplifier 160 is then applied to a second amplifier 170 for further amplification. A sync separator circuit 190 separates the horizon-

tal synchronization pulses from the composite signal output of amplifier 170 and couples them to a discriminator circuit 210. The discriminator is designed to provide a control voltage when the synchronization signals from separator 190 vary from the nominal horizontal sync rate due to groove velocity changes. Thus, it is seen that the synchronization signal frequency provides a pilot tone recorded on the disc which can be detected by discriminator 210 to provide a control voltage indicating when the recorded sync signal frequency deviates from its proper value due to relative groove velocity error. The control signal from discriminator 210 is applied to the mechanism 125 of FIGURE 3 to provide a corrective longitudinal motion to the stylus arm 106 in a direction to tend to cancel the relative groove velocity error. The operation of such a groove velocity corrector and detector circuit is explained in greater detail in the aforementioned application 13074/72 (Serial No. 1 383 336).

The composite signal from amplifier 170 is also, illustratively, applied to an amplitude modulator circuit 180. Oscillator 220 has a frequency chosen to coincide with one of the UHF or VHF channels of a television receiver and supplies a carrier wave to the modulator which is amplitude modulated by the video and synchronization signals from amplifier 170. The amplitude modulated signal from stage 180 may be coupled directly to the antenna terminals of a standard television receiver, so that the latter may effect a display of the recorded video signals.

WHAT WE CLAIM IS:—

1. A high-density information record system comprising: a disc record having a constant-width spiral groove in a surface thereof, the center-to-center spacing of successive convolutions thereof being substantially constant and independent of recorded information; said groove containing an information track constituted by variations in the geometry of the bottom of the groove representative of recorded information, and having sidewalls of a configuration which is substantially constant throughout said successive convolutions and independent of the groove bottom geometry variations representative of recorded information; a stylus having a tip receivable in said disc groove during playback; said stylus including a support element of insulating material and an electrode of conductive material supported thereby, said electrode presenting a surface to the disc groove bottom when said tip is received in said disc groove; means for effecting rotational relative motion between said disc and said stylus with the stylus tip received in and travelling along the groove;

and means electrically connected to said stylus electrode for developing an electrical signal representative of groove bottom geometry variations passing said stylus electrode surface during such relative motion.

2. A system according to claim 1 wherein the geometry variations in the bottom of the disc groove are representative of video signals.

3. A system according to claim 1 or 2 wherein the geometry variations in the bottom of the groove constitute variations in the depth of the groove longitudinally of the groove whereby to provide corresponding variations in the spacing between the bottom of the groove and said surface of the stylus electrode as the stylus tip travels along the groove.

4. A system according to any preceding claim wherein said surface of the stylus electrode has a greater dimension in a lateral direction extending between said groove sidewalls and a lesser dimension in a longitudinal direction along said groove and normal to said lateral direction.

5. A system according to any preceding claim wherein the stylus support provides the stylus tip with insulating sidewalls for disc groove sidewall engagement without such engagement by the stylus electrode.

6. A system according to claim 5 wherein the stylus electrode is centrally located with respect to said stylus sidewalls.

7. A system according to claim 5 or 6 wherein the stylus electrode is embedded in the support element of the stylus.

8. A system according to any preceding claim including reference conductor means disposed in proximity to said information track whereby said geometry variations of the bottom of the groove provide corresponding capacitance variations between said stylus electrode surface and said reference conductor means, the means connected to the stylus electrode for developing said electrical signal being responsive to said capacitance variations.

9. A system according to claim 8 wherein said reference conductor means comprises a conductor surface on a disc-supporting turntable rotatable to effect said rotational relative motion.

10. A system according to claim 8 or 9 wherein said means electrically connected to the stylus electrode comprises a resonance circuit incorporating the capacitance exhibited between said stylus electrode surface and said reference conductor means; means for applying oscillations to said resonance circuit, and means including an amplitude detector coupled to the resonance circuit for developing a signal representative of the re-



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tal synchronization pulses from the composite signal output of amplifier 170 and couples them to a discriminator circuit 210. The discriminator is designed to provide a control voltage when the synchronization signals from separator 190 vary from the nominal horizontal sync rate due to groove velocity changes. Thus, it is seen that the synchronization signal frequency provides a pilot tone recorded on the disc which can be detected by discriminator 210 to provide a control voltage indicating when the recorded sync signal frequency deviates from its proper value due to relative groove velocity error. The control signal from discriminator 210 is applied to the mechanism 125 of FIGURE 3 to provide a corrective longitudinal motion to the stylus arm 106 in a direction to tend to cancel the relative groove velocity error. The operation of such a groove velocity corrector and detector circuit is explained in greater detail in the aforementioned application 13074/72 (Serial No. 1 383 336). The composite signal from amplifier 170 is also, illustratively, applied to an amplitude modulator circuit 180. Oscillator 220 has a frequency chosen to coincide with one of the UHF or VHF channels of a television receiver and supplies a carrier wave to the modulator which is amplitude modulated by the video and synchronization signals from amplifier 170. The amplitude modulated signal from stage 180 may be coupled directly to the antenna terminals of a standard television receiver, so that the latter may effect a display of the recorded video signals.

WHAT WE CLAIM IS:—

1. A high-density information record system comprising: a disc record having a constant-width spiral groove in a surface thereof, the center-to-center spacing of successive convolutions thereof being substantially constant and independent of recorded information; said groove containing an information track constituted by variations in the geometry of the bottom of the groove representative of recorded information, and having sidewalls of a configuration which is substantially constant throughout said successive convolutions and independent of the groove bottom geometry variations representative of recorded information; a stylus having a tip receivable in said disc groove during playback; said stylus including a support element of insulating material and an electrode of conductive material supported thereby, said electrode presenting a surface to the disc groove bottom when said tip is received in said disc groove; means for effecting rotational relative motion between said disc and said stylus with the stylus tip received in and travelling along the groove;

and means electrically connected to said stylus electrode for developing an electrical signal representative of groove bottom geometry variations passing said stylus electrode surface during such relative motion.

2. A system according to claim 1 wherein the geometry variations in the bottom of the disc groove are representative of video signals.

3. A system according to claim 1 or 2 wherein the geometry variations in the bottom of the groove constitute variations in the depth of the groove longitudinally of the groove whereby to provide corresponding variations in the spacing between the bottom of the groove and said surface of the stylus electrode as the stylus tip travels along the groove.

4. A system according to any preceding claim wherein said surface of the stylus electrode has a greater dimension in a lateral direction extending between said groove sidewalls and a lesser dimension in a longitudinal direction along said groove and normal to said lateral direction.

5. A system according to any preceding claim wherein the stylus support provides the stylus tip with insulating sidewalls for disc groove sidewall engagement without such engagement by the stylus electrode.

6. A system according to claim 5 wherein the stylus electrode is centrally located with respect to said stylus sidewalls.

7. A system according to claim 5 or 6 wherein the stylus electrode is embedded in the support element of the stylus.

8. A system according to any preceding claim including reference conductor means disposed in proximity to said information track whereby said geometry variations of the bottom of the groove provide corresponding capacitance variations between said stylus electrode surface and said reference conductor means, the means connected to the stylus electrode for developing said electrical signal being responsive to said capacitance variations.

9. A system according to claim 8 wherein said reference conductor means comprises a conductor surface on a disc-supporting turntable rotatable to effect said rotational relative motion.

10. A system according to claim 8 or 9 wherein said means electrically connected to the stylus electrode comprises a resonance circuit incorporating the capacitance exhibited between said stylus electrode surface and said reference conductor means; means for applying oscillations to said resonance circuit, and means including an amplitude detector coupled to the resonance circuit for developing a signal representative of the re-



corded information as represented by said capacitance variations.

11. A stylus, for use in playback of a grooved disc record, said stylus comprising: a stylus tip having insulating sidewalls for disc groove sidewall engagement, said insulating sidewalls being provided by a support element of insulating material; and a conductive electrode supported by said support element and having a surface positioned so as to be presented towards the disc groove bottom when the stylus tip is received in the groove, this stylus electrode having a lateral dimension, in a direction extending between said insulating sidewalls, which is less than the distance between said insulating sidewalls whereby to preclude disc groove sidewall engagement of said conductive electrode.

12. A stylus according to claim 11 wherein said electrode is substantially centrally located with respect to said insulating sidewalls of the stylus.

13. A stylus according to claim 11 or 12 wherein said electrode is embedded in the support element.

14. A stylus according to claim 11, 12 or 13 wherein said surface of the electrode has a dimension in the direction extending between the stylus sidewalls which is substantially greater than the transverse dimension of said surface.

15. A stylus according to claim 14 wherein said transverse dimension of said electrode surface is not greater than 1 micrometer.

16. Video playback apparatus, for use with a grooved video disc, comprising the combination of a stylus including a tip having insulating sidewalls for disc groove sidewall engagement when received in a disc groove, said insulating sidewalls being provided by a support element of insulating material; said stylus tip also including a conductive electrode supported by said insulating support element and having a surface positioned so as to be presented towards the disc groove bottom when the stylus tip is received therein, said conductive electrode having a lateral dimension, in a direction extending between said insulating sidewalls, which is substantially greater than the transverse dimension of said electrode but not exceeding the distance between said insulating sidewalls of said tip; a turntable

for supporting a video disc in a playing position permitting such disc groove reception of said stylus tip and establishment of relative motion between said disc groove and stylus tip by rotation of the turntable; and means electrically coupled to said stylus electrode for developing an electrical signal representative of information recorded on said disc when said relative motion occurs.

17. Playback apparatus according to claim 16 wherein the stylus electrode has its lateral dimension less than the distance between said sidewalls of the stylus tip and is centrally located with respect to said sidewalls of the stylus.

18. Playback apparatus according to claim 16 or 17 wherein the stylus electrode is embedded in the stylus support element.

19. Playback apparatus according to claim 16, 17 or 18 wherein the turntable presents a reference conductive surface in proximity to a disc supported thereon whereby to present between said reference surface and said surface of the stylus when the latter is received in a disc groove a capacitance which will vary according to the recorded information during said relative motion between the stylus tip and the disc groove.

20. Playback apparatus according to claim 19 further including a resonance circuit incorporating said capacitance, means for applying oscillations to said resonance circuit, and means for detecting variations in the amplitude of oscillations appearing across said resonance circuit during said relative motion.

21. Playback apparatus according to claim 20 wherein said resonance circuit includes an inductive element connected between the stylus electrode and said reference surface.

22. A disc record playback stylus substantially as hereinbefore described with reference to Figures 1 and 2 of the accompanying drawings.

23. A disc record playback apparatus substantially as hereinbefore described with reference to Figures 3 and 4 of the accompanying drawings.

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