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(54) **SYSTEM AND METHOD FOR CONTROLLING A DIGITAL AUDIO SOURCE**

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This patent is subject to a terminal disclaimer.

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(58) **Field of Classification Search**
USPC 84/600–602; 369/9, 69, 70, 6, 709
See application file for complete search history.

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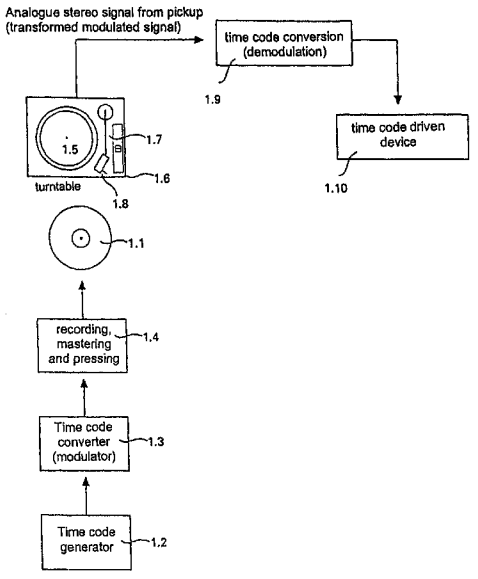
(57) **ABSTRACT**

An apparatus for signal processing, wherein a disc is placed on a turntable and is provided with a groove which can be followed by the pick-up element, and employing a time-code signal wherein during use of the disc the said time-code signal controls the digital audio source.

20 Claims, 3 Drawing Sheets



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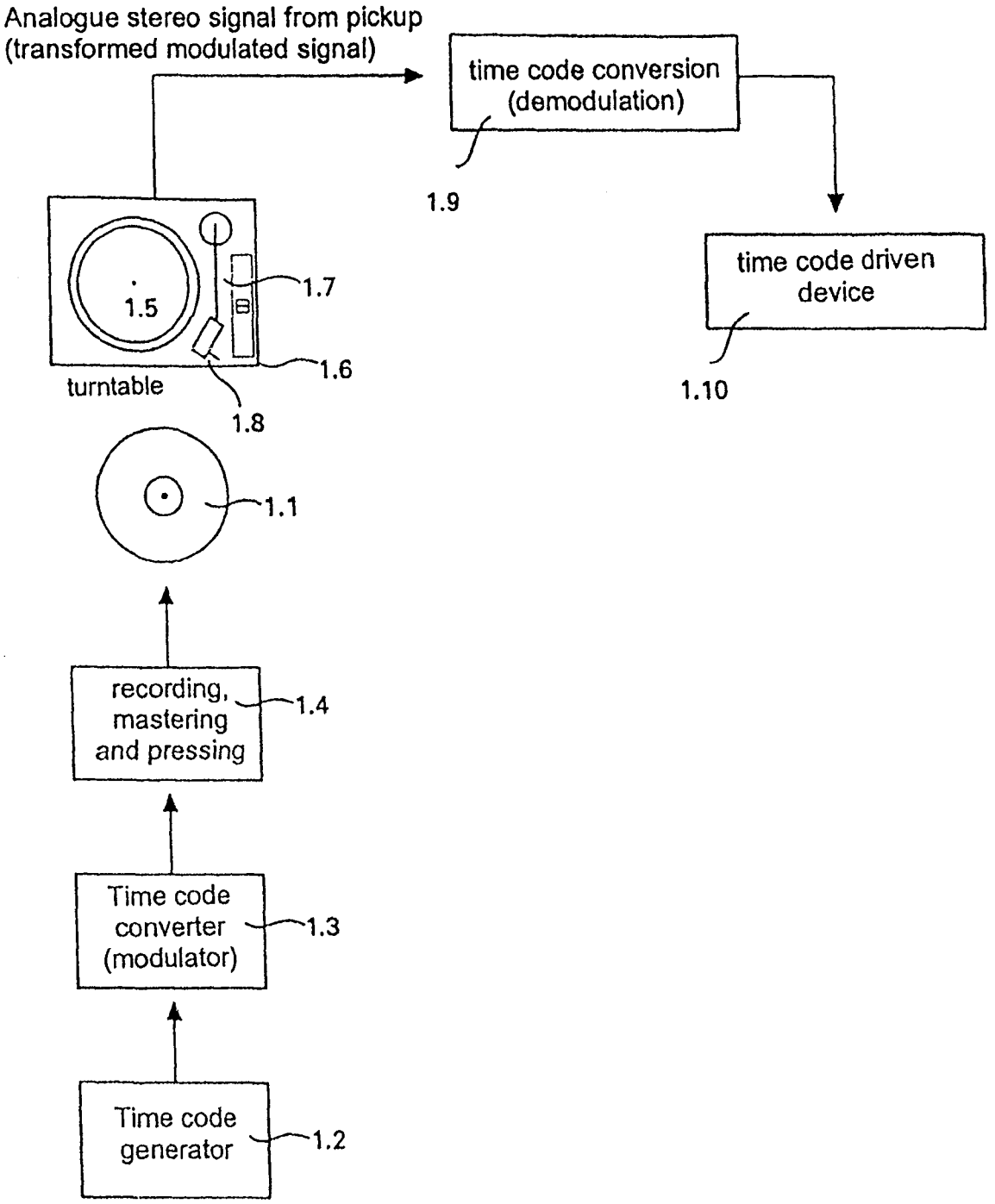
Analogue stereo signal from pickup
(transformed modulated signal)
time code conversion
(demodulation)
1.9
time code driven
device
1.10
1.5
1.7
1.6
turntable
1.8
1.1
recording,
mastering
and pressing
1.4
Time code
converter
(modulator)
1.3
Time code
generator
1.2

FIG. 1

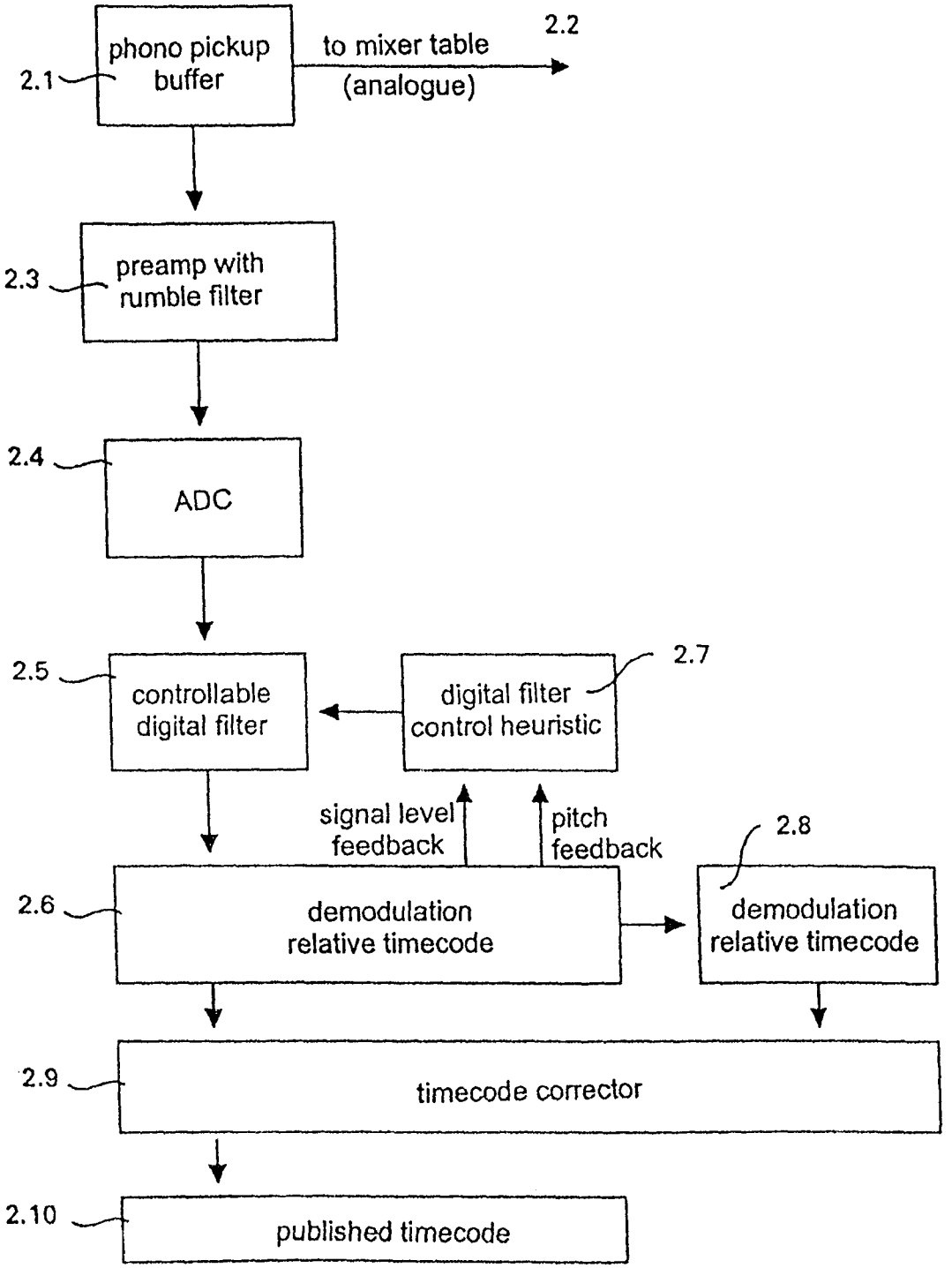
phono pickup buffer
2.1
to mixer table (analogue)
2.2
preamp with rumble filter
2.3
ADC
2.4
controllable digital filter
2.5
digital filter control heuristic
2.7
signal level feedback
pitch feedback
demodulation relative timecode
2.6
demodulation relative timecode
2.8
timecode corrector
2.9
published timecode
2.10

FIG. 2

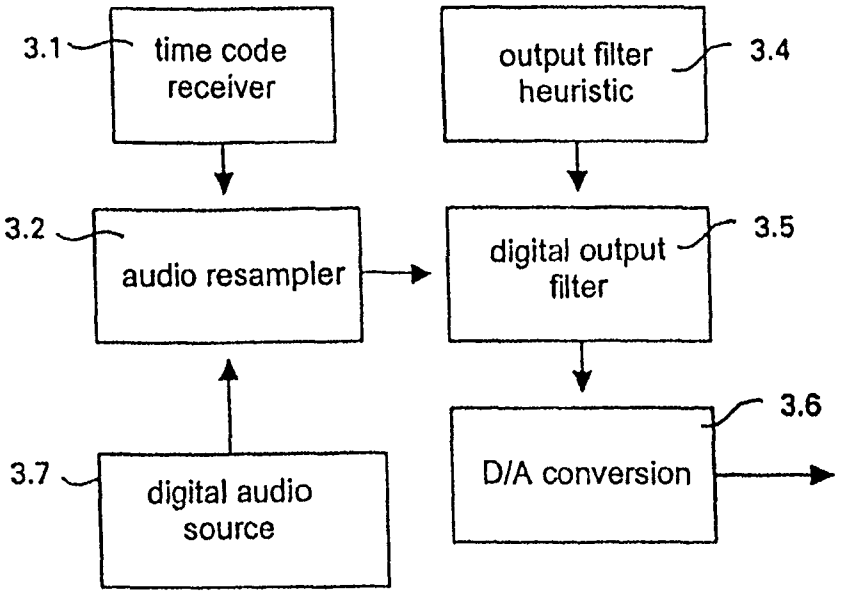
3.1
time code receiver
output filter heuristic
3.4
3.2
audio resampler
digital output filter
3.5
3.6
D/A conversion
3.7
digital audio source

FIG. 3

SYSTEM AND METHOD FOR CONTROLLING A DIGITAL AUDIO SOURCE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of U.S. patent application Ser. No. 12/507,242, entitled "Apparatus for Controlling a Digital Audio Source", filed on Jul. 22, 2009, which is a continuation application of U.S. patent application Ser. No. 11/773,195, entitled "Method For Signal Processing, And Apparatus Therefore", filed on Jul. 3, 2007, which is a continuation application of U.S. patent application Ser. No. 11/355,851, entitled "Disc For Use In An Apparatus For Signal Processing, And Such An Apparatus", filed on Feb. 15, 2006, which is now U.S. Pat. No. 7,238,874, issued Jul. 3, 2007, which is a divisional application of patent application Ser. No. 10/133,846, entitled "Disc For Use In An Apparatus For Signal Processing, And Such An Apparatus", filed on Apr. 26, 2002, which is now U.S. Pat. No. 7,012,184, issued Mar. 14, 2006, which is a Continuation of International Application Number PCT/NL01/00055 filed on Jan. 26, 2001 entitled "Disc For Use In An Apparatus For Signal Processing, And Such An Apparatus", which is a continuation and claims priority to The Netherlands application number NL 1014526, entitled "Disc For Use In An Apparatus For Signal Processing, And Such An Apparatus", filed Feb. 29, 2000. The specification and claims thereof are incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

INTRODUCTION

The invention primarily relates to a disc for use in an apparatus for signal processing. Further, the invention relates to such an apparatus for signal processing.

BACKGROUND OF THE INVENTION

From WO 97/01168, a system is known for the digital processing of audio signals which is particularly suitable for disc jockeys and scratch artists. The speed and direction of a digital audio signal, for instance derived from a CD player, can be controlled according to this citation by the manual control of a rotational element. This rotational element is placed for instance on a turntable of a conventional record player and is being read by means of an optical sensor determining the speed and direction of rotation of the turntable. The data that are obtained thereby are being used to control the speed and direction of reproduction of the CD player. The problem associated with this known apparatus is, however, that it is hardly usable by disc jockeys and in scratch applications for the reason that from a given position of the reading head of the CD player only continuously developing relative movements are possible that depend on the control of the earlier mentioned rotational element. In the known apparatus, it is for instance not possible to make swift reproductions of different musical segments on the CD in a way that is reproducible and can be controlled satisfactorily. Also the authentic scratch sound which can be realized by means of a conventional record, cannot be obtained with the known apparatus.

SUMMARY OF THE INVENTION

With the invention it is intended to improve this and to provide a system which allows to provide a sound impression with a digital sound source which conforms to the possibilities that exist with conventional records, and with which quickly digitally recorded (musical) fragments can be located.

In a first aspect of the invention, a disc is proposed therefore which is designed for use in such an apparatus for signal processing, such that the disc during its use is placed on the turntable and is provided with a groove which can be followed by the pick-up element, and which comprises a time-code signal wherein during use of the disc the said time-code signal controls the digital audio source.

A practical embodiment of the disc is characterized in that the time-code signal is an absolute time-code signal that is comprised in the groove in a predetermined number subsequently arranged discrete steps. It is advisable to select the number of discrete steps in such way that the resolution is sufficiently high to realize the intended effect. In practice this means that the number of discrete steps may count five per second.

From a view point of cost efficiency and also to make a natural connection to the known scratching techniques with conventional records, it is desirable that the time-code signal is modulated on a carrier frequency in the audible range between 20 and 20,000 Hz. In this way, it is possible to simply use normal audio equipment for playing the disc.

In a further aspect of the invention, the apparatus for signal processing is so equipped that the pick-up element feeds a digital filter which has a phase-locked loop circuit for detecting and following a carrier frequency, and a demodulation circuit for demodulating the time-code signal that is modulated on the carrier frequency. The disc and the apparatus for signal processing can then cooperate such that the absolute time-code signal that is present on the disc, provides the control for the digital audio source.

It is further advantageous that the groove of the disc comprises a time-code signal in both the left and the right channel, which are mutually shifted in phase. In this way, a quick determination of the direction in respect of the rotation of the disc can be extracted.

Appropriately then the apparatus is equipped with a detection device for determining a phase difference between the time-code signal demodulated from the left and the right signal, respectively. In this way, the desired direction of play of the digital audio equipment can be determined already when the needle is lowered onto the disc according to the invention without noticeable delay, enhancing the impression that one is working with an entirely conventional analogue audio installation.

A suitable embodiment of the apparatus is characterized in that it comprises a digital audio buffer being under control of the time-code signal, and that the digital audio buffer is connected to a digital output filter which feeds a signal output which is selected from the group formed by a digital electric output socket, a digital optic signal output, and a D/A converter.

The scratch effect can be manufactured in such an apparatus particularly adequately when it comprises control logic being fed by the time-code signal for determining a velocity signal being a measure for the speed of change of the time-code signal, and that the digital output filter is being controlled by the said control logic.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be further elucidated in respect of a non-limiting embodiment explaining the disc and its use in an apparatus according to the invention in a schematic diagram.

FIG. **1** shows schematically the apparatus for signal processing according to according to one embodiment of the present invention and the disc to be used thereby.

FIG. **2** show as block diagrams the signal processing applied in the apparatus according to one embodiment of the present invention.

FIG. **3** then show as block diagrams the signal processing applied in the apparatus according to according to one embodiment of the present invention the invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** shows a disc **1.1** which is manufactured according to known manufacturing techniques that have been in use for many years now in the manufacture of conventional records. The disc **1.1** is provided with an absolute time-code signal by making use of a time-code generator **1.2** controlling a modulator **1.3** which supplies a carrier frequency modulated by the time-code generator **1.2** and which is applied to the disc **1.1** as the only signal. Block **1.4** shows the conventional manufacturing method of recording, making of the master disc, and pressing the final vinyl disc **1.1**. The disc **1.1** can be placed on a turntable **1.5** of a record player **1.6**, which is further provided with an arm **1.7** and a pick-up element **1.8**.

The pick-up element **1.8** can follow the groove in the disc **1.1** that comprises the absolute time-code signal, and the pick-up element **1.8** is connected to the apparatus part **1.9** for demodulating the carrier signal in order to provide the (digital) time-code signal, which serves for the control of the digital audio source **1.10**, for instance a CD player, a DVD player, an MP3 reproduction device, or the like.

The operation of the apparatus part **1.9** according to FIG. **1** will hereafter be further elucidated with reference to FIG. **2**. The operation of the digital audio source **1.10** which stands under control of the time-code signal will hereafter be further elucidated with reference to FIG. **3**.

Referring now first to FIG. **2**, it is shown that the signal that is derived from the pick-up element **1.8** according to FIG. **1**, is fed to a input buffer **2.1** from which a signal may be finally led to a mixing table **2.2** in order to provide for the situation that the turntable **1.5** according to FIG. **1** carries a conventional analogue vinyl record. The just-mentioned input buffer **2.1** feeds a preamplifier **2.3**, provided with a low rejector circuit, and which feeds in turn an analogue/digital converter **2.4**, for instance a 16-bit or 20-bit converter, depending on the desired resolution. The reference numerals **2.5**, **2.6** and **2.7** refer to a digital filter, the operation of which depends on, inter alia, the speed of movement of the disc **1.1** according to FIG. **1** vis-a-vis the pick-up element **1.8**. The apparatus part **2.7** of FIG. **2** may comprise a phase-locked loop circuit for detecting and following the carrier frequency which is provided on the disc **1.1** according to FIG. **1**. In the current implementation, however, use is made of a moving average filter supplemented with detection means for detecting a stand-still of the disc **1.1**. Furthermore, demodulation takes place in the circuit of apparatus part **2.6** for demodulating the time-code signal that is modulated on the carrier frequency. Although the above subject matter is shown and explained as the signal in a single channel, it is preferable according to the invention that a left and a right channel is present, and that the detection apparatus which forms part of the digital filter **2.5**, **2.6**, **2.7** is made in duplicate so as to allow a phase difference between the left and the right channel carrying the demodulated time-code signal to be determined. In this manner, the correct place and direction of movement of the disc **1.1** in relation to the pick-up element **1.8** according to FIG. **1** can be determined with high resolution.

The phase difference between the left and right channel is useful to extract the directional information very quickly when the pick-up element **1.8** is suddenly lowered onto the rotating disc **1.1**. The absolute time-code which is determined from the carrier frequency is subsequently used together with the relative time-code, which is based on the difference between the left and the right channel, to determine an accurate time-code signal **2.10** which serves to control the digital audio source **1.10** as shown in FIG. **1**. The time-code signal **2.10** of FIG. **2** is therefore read into apparatus part **3.1** (see FIG. **3**) of the digital audio source, wherein same provides a direct control of a digital audio reader **3.2** reading the desired digital information from the correct place of for instance a CD disc. This digital audio information is being transferred from apparatus part **3.2** to a digital output filter **3.5** which is being controlled by control logic **3.4**, and which determines from the time-code signal which is read into apparatus part **3.1**, the speed of change of the time-code signal. This speed of change signal which is derived from the time-code signal, determines the parameters of the digital output filter **3.5**. In a manner known to the expert, the digital output filter **3.5** can then feed a digital electric output socket, a digital optical signal output, or a D/A converter. This last provision is shown in the Figure with reference numeral **3.6**.

The present invention has been described in terms of preferred embodiments, however, it will be appreciated that various modifications and improvements may be made to the described embodiments without departing from the scope of the invention.

What is claimed is:

1. A method for controlling the play of sound from an audio source, the method comprising:

reading, from a disc rotating on a player, an absolute control signal indicative of speed of disc play and directionality of disc play;

determining a relative control signal based on a phase difference between a left channel and a right channel of the absolute control signal; and

processing the absolute control signal and the relative control signal to determine an accurate time-code signal serving to control sound play of an audio source at a speed and direction corresponding to that of the disc play,

wherein processing the absolute control signal and the relative control signal includes subjecting at least one of the absolute and relative control signals to time-code correction.

2. The method for controlling the play of sound according to claim **1**, wherein the absolute control signal comprises information sufficient to determine speed and directionality of disc play.

3. The method for controlling the play of sound according to claim **1**, wherein the absolute control signal includes a control signal with a time-code indicative of position of play on the disc.

4. The method for controlling the play of sound according to claim **3**, wherein the absolute control signal comprises a right and a left channel carrying signals shifted in phase, wherein the relative control signal is determined based on the phase difference between the right and left channels.

5. The method for controlling the play of sound according to claim 1, wherein the relative time-code signal is indicative of directionality of disc movement.

6. A system for controlling play of sound from an audio source, the system comprising:

a disc including a control signal indicative of speed of disc play, directionality of disc play and place on the disc of play;

a first digital filter which processes the control signal to determine a relative control signal based on a phase difference between a left channel and a right channel of the control signal; and

a second digital filter which processes the control signal and the relative control signal to determine an accurate time-code signal serving to control, without noticeable delay, sound play from an audio source at a speed, direction, and position corresponding to that of the disc play,

wherein processing the control signal and the relative control signal includes subjecting one or more of the control signal and the relative control signal to time-code correction.

7. The system for controlling the play of sound according to claim 6, wherein the control signal is in the audible range of 20 to 20,000 Hz.

8. The system for controlling the play of sound according to claim 6, wherein the control signal comprises information sufficient to determine speed and directionality of disc play.

9. The system for controlling the play of sound according to claim 6, wherein the control signal includes an absolute time-code signal indicative of position of play on the disc.

10. An apparatus for controlling an audio source, comprising:

a player;

a disc comprising an absolute time-code signal in the audible range, wherein the disc rotates on the player;

a pick-up element deriving the absolute time-code signal from the disc;

a time-code corrector correcting the derived time-code signal; and

a time-code receiver receiving the corrected time-code signal to be used to control an audio source,

wherein the absolute time-code signal comprises a right channel and a left channel, and

wherein a relative time-code signal is determined by detecting a phase difference between the right channel and the left channel.

11. The apparatus according to claim 10, wherein the audio source comprises one or more of a CD player, a DVD player, and an MP3 device.

12. The apparatus according to claim 11, wherein control of the audio source includes controlling the play of sound from the audio source.

13. The apparatus according to claim 10, wherein the speed and the direction of play of the audio source is controlled by the corrected time-code signal.

14. The apparatus according to claim 10, wherein the direction of the play of the audio source is controlled by the relative time-code signal.

15. The apparatus according to claim 10, wherein the time-code signal includes a control signal indicative of position of play on the disc and wherein the position of play of the audio source is controlled by the corrected time-code signal.

16. A method for controlling the play of sound from an audio source, the method comprising:

reading, from a disc rotating on a player, an absolute control signal indicative of speed of disc play and directionality of disc play;

determining a relative control signal based on a phase difference between a left channel and a right channel of the absolute control signal;

processing the absolute control signal and the relative control signal to determine an accurate time-code signal; and

utilizing the accurate time-code signal to control sound play of an audio source at a speed and direction corresponding to that of the disc play.

17. A method for controlling an audio source, comprising:

processing a disc rotationally on a player, wherein the disc comprises a control signal in the audible range between 20 and 20,000 Hz;

deriving the control signal from the disc with a pick-up element;

determining a relative control signal based on a phase shift between a right channel and a left channel of the control signal;

processing the control signal and the relative control signal to determine an accurate control signal; and

reading the accurate control signal into a receiver to provide control of an audio source.

18. The method according to claim 17, wherein control of the audio source includes controlling the speed and the direction of play of the audio source.

19. The method according to claim 17, wherein control of the audio source includes controlling the play of sound from the audio source.

20. The method according to claim 17, wherein the audio source comprises one or more of a CD player, a DVD player, and an MP3 device.

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