

## Method and apparatus for controllably rotating an information storage disc

## Background of the invention

The present invention relates generally to systems for recovering information from a record medium, and, more particularly, to systems for recovering information from an information storage disc that is rotatable at a variable angular velocity.

Information storage discs having a plurality of substantially circular and concentrically arranged information tracks are becoming increasingly popular, particularly when used for storing video signals. Each information track on the disc typically stores one complete frame of the video signal, so recovery of the video signal at a prescribed constant rate necessary for proper reception of the signal by a conventional television receiver ordinarily necessitates a rotation of the disc relative to a transducer at a substantially constant angular velocity.

## Summary of the invention

The present invention is embodied in apparatus and a related method for controllably rotating an information storage disc relative to transducer means for recovering information stored thereon. The information is stored in a plurality of substantially circular and concentrically arranged information tracks, and the transducer means is radially movable relative to the disc to recover the information from a selected one of the tracks. The recording density of the stored information is such that, to recover the information at a prescribed constant rate, the disc must be rotated at an angular velocity that varies according to the radius of the selected track.

The apparatus includes means for producing a coarse speed control signal that varies according to the radius of the selected information track, means for applying a fine speed control signal to the coarse signal for producing a composite speed control signal representative of the prescribed speed at which the disc is to be rotated, and means responsive to the composite speed control signal for rotating the disc, accordingly. Such an apparatus is known from FR—A—2 312 833. In accordance with the present invention, the apparatus further includes means for comparing a periodic signal included in the information recovered from the disc with a periodic reference signal having a predetermined constant frequency, and for producing a corresponding fine speed control signal that is coupled to the means for producing the composite speed control signal, to adjust such composite signal in a prescribed fashion, accordingly. As a result, the angular velocity of the disc is controllably adjusted, such that the information is recovered therefrom by the transducer means at the prescribed constant rate.

More particularly, an apparatus constructed

in accordance with the present invention is especially adapted for use in recovering a video signal from an information storage disc having a substantially uniform recording density over its entire information-bearing surface. To properly recover the video signal, the angular velocity of the disc relative to the transducer means must be maintained substantially inversely proportional to the radius of the information track from which information is being recovered by the transducer means.

The coarse speed control means preferably comprises a potentiometer mechanically coupled to the transducer means, which is movable radially relative to the disc. An electrical signal produced by the potentiometer is substantially proportional to such radius and is coupled to the means for producing the composite speed control signal, which, in the preferred embodiment comprises a voltage-controlled oscillator (VCO). The composite speed control signal produced by the VCO has a frequency substantially inversely proportional to the radius of the selected track, and is coupled to a conventional servomechanism for rotating the disc at a corresponding angular velocity. Thus, as a result of the coarse speed control means, alone, the angular velocity of the disc will be controllably adjusted as the transducer means moves from track to track, and, depending on the linearity of the potentiometer and the VCO, the resultant velocity will be within a prescribed tolerance of the precise velocity necessary for recovering the information at the prescribed constant rate.

A fine adjustment of the angular velocity of the disc is accomplished by the fine speed control means, which operates to compare the timing of the video signal recovered from the disc with a periodic reference signal. The fine speed control means preferably includes a phase-locked loop for detecting a pilot signal included in the video signal recovered from the disc and producing a periodic signal having a corresponding frequency, along with a stable reference oscillator for generating the periodic reference signal. The respective periodic signals are suitably frequency divided and compared to each other in a phase detector to produce the fine speed control signal, which has an average voltage proportional to the difference in the phase angles of the respective signals.

The fine speed control signal is transmitted to a summing amplifier, where it is combined with the coarse speed control signal, for coupling to the VCO. As a result, the frequency of the composite speed control signal produced by the VCO will be adjusted automatically, to cause the servo to rotate the disc at an appropriate angular velocity such that the video signal is recovered from the disc at the prescribed constant rate. By way of example, if the coarse

speed control means, by itself, operated to rotate the disc at too low an angular velocity, the fine speed control means would detect a relative phase lag in the recovered video signal and would adjust the average voltage level of the fine speed control signal it produces, accordingly. The voltage applied to the VCO would thus be controllably adjusted, whereby the frequency of the composite speed control signal would be increased and the angular velocity of the disc increased, accordingly, until the proper speed were achieved. The apparatus would operate in a similar fashion to decrease the angular velocity of the disc if a phase lead in the recovered video signal were detected.

Other aspects and advantages of the present invention will become apparent from the following description of the preferred embodiment taken in conjunction with the accompanying drawings, which disclose, by way of example, the principles of the invention.

#### Brief description of the drawings

Figure 1 is a plan view of a prior video disc, showing, in schematic form, two information tracks, each extending over one complete circumference and containing one frame of a video signal:

Figure 2 is a plan view of the video disc of Figure 1, showing, in enlarged form, the successive light-reflective and light-scattering regions forming the two information tracks;

Figure 3 is a simplified block diagram of a prior art apparatus for rotating the video disc of Figure 1 at a constant angular velocity, to recover the video signal therefrom;

Figure 4 is a plan view of a video disc for use with apparatus of the present invention, showing, in schematic form, a plurality of frames of a video signal recorded on the disc, each of the frames having substantially the same length;

Figure 5 is a plan view of the video disc of Figure 4, showing, in enlarged form, the successive light-reflective and light-scattering regions for two information tracks, one located near the periphery of the disc and the other near the center of the disc; and

Figure 6 is a simplified block diagram of apparatus of the present invention for rotating the video disc of Figure 4 at a precisely controllable angular velocity, such that the video signal is recovered from the disc at a prescribed rate.

#### Description of the preferred embodiment

Referring now to the drawings, and particularly to Figures 1 and 2, there is shown a typical prior art record disc 10 for storing information, such as a video signal. As shown in Figure 1, the signal is recorded in a plurality of substantially circular information tracks forming a spiral pattern on the disc, with each track containing one frame of video information. The even fields for all of the tracks form a sector indicated by the reference numeral 12, while

the odd fields form a sector indicated by the numeral 14 and the vertical blanking intervals form sectors indicated at 16 and 18. It will be apparent that an information track located at the periphery of the video disc 10, such as the track indicated by the numeral 19, is of considerably longer length than is an information track located nearer the center of the disc, such as the track indicated by the numeral 20.

Figure 2 is another schematic view of the disc shown in Figure 1, wherein indicia of the recorded video signal are shown in enlarged form. The video signal is ordinarily stored on the disc 10 in the form of a frequency modulated carrier and it comprises an alternating sequence of light-reflective and light-scattering regions, 24 and 26, respectively. The light-scattering regions 26 normally have a uniform width in the radial direction, and the lengths of adjacent light-scattering and light-reflective regions are essentially equal, because, together, they represent a single cycle of the frequency modulated signal. Since the same amount of information is recorded on each track, e.e., one video frame, the size of the successive light-scattering regions changes as a function of its radial position. This can be observed in Figure 2 by noting the relative sizes of the light-reflective and light-scattering regions, 24 and 26, respectively, for a track near the periphery of the disc 10, and the light-reflective and light-scattering regions, 24' and 26', respectively, for a track near the center of the disc.

Figure 3 is a simplified block diagram of a prior art system utilized in rotating the disc 10 of Figures 1 and 2 at a constant angular velocity of 30 revolutions per second. The system includes an oscillator 30 for generating a reference frequency that is frequency divided by a divider circuit 32 to produce a speed reference signal, a spindle motor 28, and an AC tachometer 34 coupled to the spindle motor for producing a signal having a frequency proportional to the actual angular velocity of the disc 10. The system further includes a phase detector circuit 36 for comparing the respective phase angles of the tachometer signal and the speed reference signal and for producing a corresponding control signal. The control signal is, in turn, processed in a lead/lag compensator 38 and an amplifier 40 for coupling to the motor 28 to controllably adjust its angular velocity to properly rotate the disc 10 at 30 revolutions per second.

Referring now to Figures 4 and 5, there is shown a video disc 110 for use with apparatus of the present invention. Figure 4 shows, in schematic form, one frame 112 of a video signal, extending over one complete information track near the center of the disc, along with a plurality of consecutive video signal frames 114, 116, 118, and 120 extending over a pair of tracks located near the periphery of the disc, each of these latter frames extending over substantially less than a complete circum-

ference of the disc. The length of each frame on the disc is substantially the same.

Figure 5 shows, in enlarged form, the successive light-reflective and light-scattering regions 124 and 126 for a portion of the video signal frame designated 118, along with corresponding regions 124' and 126' for a portion of the frame designated 112. It should be noted that, since each video signal frame recorded on the disc is substantially of equal length, the nominal lengths of the respective light-scattering regions 126 and 126' are, likewise, substantially equal.

Referring now to Figure 6, there is shown a simplified block diagram of apparatus for controllably rotating the disc 110 of Figures 4 and 5 at a variable angular velocity relative to an optical transducer 128, such that the video signal is recovered from the disc at a prescribed constant rate. The optical transducer is movable radially relative to the disc to recover the video signal from a selected one of the information tracks, and the apparatus operates to rotate the disc such that the selected track is moved at a substantially constant linear velocity relative to the transducer. The prescribed constant rate at which the video signal is recovered from the disc corresponds to conventional broadcast format standards, whereby the signal can be properly received and displayed by a conventional television receiver (not shown).

The apparatus includes a coarse speed control potentiometer 130 mechanically coupled to the transducer 128 for producing a coarse speed control signal, which is generally proportional to the radius of the particular information track from which information is being recovered, a voltage-controlled oscillator (VCO) 132, responsive to the coarse speed control signal, for producing a composite speed control signal having a frequency that corresponds thereto, along with a spindle motor servo 134, responsive to the composite speed control signal, for rotating the disc 110 at the corresponding angular velocity. The coarse speed control signal, being generally proportional to the radius of the selected track, thus yields a coarse approximation of the particular angular velocity required for recovery of the video signal at the prescribed constant rate.

In accordance with the invention, the apparatus further includes fine speed control circuitry 136 for comparing the phase angle of a periodic signal included in the information recovered from the disc 110 with that of a periodic reference signal derived from a crystal oscillator 138. The circuitry 136 produces a fine speed control signal for combination with the coarse speed control signal in a summing amplifier 140 and coupling to the VCO 132. The frequency of the composite speed control signal and, in turn, the angular velocity of the disc 110 are thus properly adjusted such that the periodic signal from the disc and the periodic reference signal from the oscillator have

synchronous frequencies, and the video signal is therefore recovered from the disc at the prescribed constant rate.

The periodic signal that is recovered from the disc 110 and detected by the fine speed control circuitry 136, preferably comprises a pilot signal, having a predetermined constant frequency, that is additively combined with the video signal. Alternatively, many other periodic signals can be utilized, such as, for example, the successive vertical or horizontal synchronization pulses or the successive chrominance bursts in the video signal, itself.

The coarse speed control potentiometer 130 is mechanically coupled to the optical transducer 128 and is adapted to produce an electrical current signal substantially directly proportional to the radius of the information track from which the transducer is recovering information. This current signal is transmitted over line 141 to the summing amplifier 140, where it is combined with the fine speed control signal supplied over line 142 from the fine speed control circuitry 136 and converted to a composite voltage signal for transmission over line 144 to the VCO 132. The VCO, in turn, produces the composite speed control signal for transmission over line 146 to the spindle motor servo 134, which operates to rotate the information disc 110 at an angular velocity corresponding to the frequency of the composite speed control signal. For reasons that will become apparent subsequently, the potentiometer 130 and the VCO 132 are preferably sufficiently linear that, disregarding the effects of the fine speed control signal, the instantaneous frequency of the composite speed control signal will always be within a tolerance of approximately 5% of the actual frequency necessary for recovery of information from the disc at the prescribed constant rate.

The spindle motor servo 134 includes a spindle motor 148 for rotating the disc 110, an AC tachometer 150 coupled to the spindle motor for producing a tachometer signal having a frequency proportional to its angular velocity, and a phase detector 152 for comparing the phase angle of the tachometer signal with that of the composite speed control signal. The phase detector produces a control signal proportional to the detected phase difference, for processing by a lead/lag compensator 154 and amplification by an amplifier 156 and, in turn, coupling to the spindle motor 148 to control its angular velocity. The servo 134 operates in a conventional manner to synchronize the respective frequencies and phase angles of the composite speed control signal and the tachometer signal, whereby the angular velocity of the spindle motor 148, and, therefore, the disc 110, are made to follow the varying frequency of the composite speed control signal.

The fine speed control circuitry 136 receives on line 158 the pilot signal included with the

video signal recovered from the disc 110, and produces the fine speed control signal for use by the apparatus in precisely adjusting the angular velocity of the disc to result in a recovery of the video signal at the proper rate. The circuitry 136 includes a phase-locked loop circuit 160 for detecting the pilot signal, along with a phase detector 162 for comparing the phase angle of the detected signal with that of the periodic reference signal derived from the crystal oscillator 138.

The phase locked loop 160 operates in a conventional manner to detect the successive cycles of the pilot signal supplied on line 158 and to produce a periodic signal having the same frequency. Use of a phase-locked loop insures that, under ordinary circumstances, spurious pulses or signal dropouts will be eliminated and a substantially noise-free periodic signal will be produced. The "pull-in range" of the phase-locked loop must exceed the maximum range of frequencies over which the frequency of the recovered pilot signal is expected to vary. Since, as previously mentioned, the tolerance on the linearity of the coarse speed control potentiometer 130 and the VCO 132 is 5%, it follows that the pull-in range of the phase-locked loop must exceed 5% of the nominal pilot signal frequency. The periodic signal produced by the phase-locked loop 160 is transmitted over line 164 to a conventional edge detector 166, which produces a short duration pulse for each transition of a particular polarity, for transmission over line 168 to a first input terminal of the phase detector 162.

The crystal oscillator 138 produces a periodic clock signal for transmission over line 170 to a divide-by-N circuit 172, where it is frequency divided to produce the periodic reference signal having the same frequency as the nominal frequency of the periodic signal produced by the phase-locked loop circuit 160. This periodic reference signal from the divide-by-N circuit is transmitted over line 174 to a conventional edge detector 176, which produces a short duration pulse for each transition of a particular polarity, for transmission over line 178 to a second input terminal of the phase detector 162.

The phase detector 162 compares the respective phase angles of the two input pulse sequences it receives from the two edge detectors 166 and 176, and produces the fine speed control signal, which has an average voltage proportional to the phase difference. The fine speed control signal is transmitted over line 142 to the summing amplifier 140, where it is combined with the coarse speed control signal for transmission to the VCO 132. When a phase lead in the pilot signal is detected by the phase detector, indicating that the video signal is being recovered from the disc 110 at a rate too high, the average voltage of the fine speed control signal will automatically increase in

value, thereby causing a corresponding decrease in the frequency of the composite speed control signal produced by the VCO, and a corresponding decrease in the angular velocity of the disc, to correct for the phase lead. Conversely, when a phase lag in the pilot signal is detected, indicating that the video signal is being recovered at a rate too low, the average voltage of fine speed control signal will automatically decrease in value, thereby causing the angular velocity of the disc to be increased, accordingly, to correct for the phase lag.

The phase detector 162 preferably comprises a bidirectional counter in the form of a 3-stage shift register in which the input from one edge detector 166 or 176 is applied to the left stage, the input from the other edge detector is applied to the right stage, and the output (i.e., the fine speed control signal) is produced by the center stage. During normal operation, a pulse received on one input will cause a positive-going transition in the output signal, and a pulse received on the other input will cause a negative-going transition in the output signal. Thus, if the pulses in the two input signals are received in an alternating fashion, indicating that they have the same frequency, the output will comprise a pulse sequence whose average voltage is proportional to the phase difference of the two inputs. This bidirectional counter is described in more detail in an article written by R. A. Millar, entitled "Digital Control of Shaft Speed and Position", published in *IEEE Spectrum*, January, 1968.

From the foregoing description, it should be apparent that the present invention provides an effective apparatus and related method for recovering information from an information storage disc having a plurality of substantially concentrically arranged information tracks, with the information being recorded on the tracks at a substantially uniform recording density. The apparatus includes both coarse and fine speed control circuitry for effecting a precise control of the angular velocity of the disc, such that the information is recovered from the disc at a prescribed constant rate.

Although the invention has been described in detail with reference to its presently preferred embodiment, it will be understood by one of ordinary skill in the art that various modifications can be made without departing from the spirit and scope of the invention. Accordingly, it is not intended that the invention be limited, except as by the appended claims.

#### Claims

1. Apparatus for controllably rotating an information storage disc relative to a transducer to recover information that is stored on the disc, in a plurality of substantially circular and concentrically arranged information tracks, said apparatus operating to recover the

video signal recovered from the disc 110, and produces the fine speed control signal for use by the apparatus in precisely adjusting the angular velocity of the disc to result in a recovery of the video signal at the proper rate. The circuitry 136 includes a phase-locked loop circuit 160 for detecting the pilot signal, along with a phase detector 162 for comparing the phase angle of the detected signal with that of the periodic reference signal derived from the crystal oscillator 138.

The phase locked loop 160 operates in a conventional manner to detect the successive cycles of the pilot signal supplied on line 158 and to produce a periodic signal having the same frequency. Use of a phase-locked loop insures that, under ordinary circumstances, spurious pulses or signal dropouts will be eliminated and a substantially noise-free periodic signal will be produced. The "pull-in range" of the phase-locked loop must exceed the maximum range of frequencies over which the frequency of the recovered pilot signal is expected to vary. Since, as previously mentioned, the tolerance on the linearity of the coarse speed control potentiometer 130 and the VCO 132 is 5%, it follows that the pull-in range of the phase-locked loop must exceed 5% of the nominal pilot signal frequency. The periodic signal produced by the phase-locked loop 160 is transmitted over line 164 to a conventional edge detector 166, which produces a short duration pulse for each transition of a particular polarity, for transmission over line 168 to a first input terminal of the phase detector 162.

The crystal oscillator 138 produces a periodic clock signal for transmission over line 170 to a divide-by-N circuit 172, where it is frequency divided to produce the periodic reference signal having the same frequency as the nominal frequency of the periodic signal produced by the phase-locked loop circuit 160. This periodic reference signal from the divide-by-N circuit is transmitted over line 174 to a conventional edge detector 176, which produces a short duration pulse for each transition of a particular polarity, for transmission over line 178 to a second input terminal of the phase detector 162.

The phase detector 162 compares the respective phase angles of the two input pulse sequences it receives from the two edge detectors 166 and 176, and produces the fine speed control signal, which has an average voltage proportional to the phase difference. The fine speed control signal is transmitted over line 142 to the summing amplifier 140, where it is combined with the coarse speed control signal for transmission to the VCO 132. When a phase lead in the pilot signal is detected by the phase detector, indicating that the video signal is being recovered from the disc 110 at a rate too high, the average voltage of the fine speed control signal will automatically increase in

value, thereby causing a corresponding decrease in the frequency of the composite speed control signal produced by the VCO, and a corresponding decrease in the angular velocity of the disc, to correct for the phase lead. Conversely, when a phase lag in the pilot signal is detected, indicating that the video signal is being recovered at a rate too low, the average voltage of fine speed control signal will automatically decrease in value, thereby causing the angular velocity of the disc to be increased, accordingly, to correct for the phase lag.

The phase detector 162 preferably comprises a bidirectional counter in the form of a 3-stage shift register in which the input from one edge detector 166 or 176 is applied to the left stage, the input from the other edge detector is applied to the right stage, and the output (i.e., the fine speed control signal) is produced by the center stage. During normal operation, a pulse received on one input will cause a positive-going transition in the output signal, and a pulse received on the other input will cause a negative-going transition in the output signal. Thus, if the pulses in the two input signals are received in an alternating fashion, indicating that they have the same frequency, the output will comprise a pulse sequence whose average voltage is proportional to the phase difference of the two inputs. This bidirectional counter is described in more detail in an article written by R. A. Millar, entitled "Digital Control of Shaft Speed and Position", published in *IEEE Spectrum*, January, 1968.

From the foregoing description, it should be apparent that the present invention provides an effective apparatus and related method for recovering information from an information storage disc having a plurality of substantially concentrically arranged information tracks, with the information being recorded on the tracks at a substantially uniform recording density. The apparatus includes both coarse and fine speed control circuitry for effecting a precise control of the angular velocity of the disc, such that the information is recovered from the disc at a prescribed constant rate.

Although the invention has been described in detail with reference to its presently preferred embodiment, it will be understood by one of ordinary skill in the art that various modifications can be made without departing from the spirit and scope of the invention. Accordingly, it is not intended that the invention be limited, except as by the appended claims.

#### Claims

1. Apparatus for controllably rotating an information storage disc relative to a transducer to recover information that is stored on the disc, in a plurality of substantially circular and concentrically arranged information tracks, said apparatus operating to recover the



information at a substantially constant rate, said apparatus comprising: means (130, Fig. 6) for producing a coarse speed control signal (141) that varies according to the radius of the particular information track from which the information is being recovered; means (136) for producing a fine speed control signal (142); means (140), responsive to the coarse speed control signal and the fine speed control signal, for producing a composite speed control signal (146) representative of the prescribed angular velocity at which the disc is to be rotated; and means (134), responsive to the composite speed control signal, for rotating the disc at the prescribed angular velocity, whereby the information stored thereon is recovered by the transducer at the prescribed constant rate, characterized in that said means for generating a fine speed control signal includes means (170, 172, 176) for producing a periodic reference signal (178) having a predetermined constant frequency and fine speed control means (162) for comparing a periodic signal (168) included in the information recovered from the disc with the periodic reference signal, and for producing said fine speed control signal (142) representative of the comparison.

2. Apparatus as defined in Claim 1, wherein: said fine speed control means includes phase detector (162) means for comparing the relative phase angles of the periodic signal recovered from the disc and the periodic reference signal; and said fine speed control signal has an average value representative of the difference in the relative phase angles of the two periodic signals.

3. Apparatus as defined in Claims 1 or 2, wherein: the periodic signal recovered from the disc is a separate pilot signal having a predetermined constant frequency.

4. Apparatus as defined in Claims 1 or 2, wherein the information stored on the disc is video information and said periodic signal is the vertical sync signal, the horizontal sync signal, the chrominance burst signal, or a combination of two or more of the vertical sync signal, the horizontal sync signal and the chrominance burst signal of the video information.

5. Apparatus as defined in any of the preceding claims, wherein said fine speed control means includes a phase-locked loop (160) for detecting the periodic signal recovered from the disc.

6. Apparatus as defined in any of the preceding claims, wherein the composite speed control signal is substantially inversely proportional to the radius of the selected information track from which information is being recovered, whereby the apparatus operates to controllably rotate the storage disc at an angular velocity substantially inversely proportional to the radius of the selected track and the disc is moved relative to the transducer at a substantially constant linear velocity.

7. Apparatus as defined in any of the Claims

1—5, wherein the coarse speed control signal is substantially directly proportional to the radius of the information track from which information is being recovered.

8. Apparatus as defined in any of the preceding claims, wherein: said transducer is movable radially relative to the disc, to be positioned in a prescribed relationship relative to the information track from which information is being recovered; and said coarse speed control means includes a potentiometer that is coupled to said transducer and that is adapted to produce the coarse speed control signal.

9. Apparatus as defined in any of the preceding claims, wherein: said means for producing a composite speed control signal includes means (140) for summing together the coarse speed control signal and the fine speed control signal, to produce a composite voltage signal, and voltage-controlled oscillator means (132), responsive to the composite voltage signal, for producing the composite speed control signal, said composite speed control signal having a frequency substantially inversely proportional to the composite voltage signal; and said means for rotating the disc is responsive to the frequency of the composite speed control signal.

10. Apparatus as defined in any of the preceding claims, wherein the transducer is moved radially relative to the disc in a continuous fashion, and the information is recovered from the successive information tracks, seriatim.

11. A method for controllably rotating an information storage disc relative to a transducer, to recover information that is stored on the disc in a plurality of substantially circular and concentrically arranged information tracks, wherein the information is recovered from the disc at a substantially constant rate, said method comprising the steps of: determining the radius of the particular information track from which information is being recovered by the transducer, and producing a coarse speed control signal in accordance therewith; producing a fine speed control signal; producing a composite speed control signal in accordance with the coarse speed control signal and the fine speed control signal, said composite signal being representative of the prescribed angular velocity at which the disc is to be rotated; and rotating the disc at the prescribed angular velocity, in accordance with the composite speed control signal, whereby the information is recovered by the transducer at the prescribed constant rate, characterized in that said steps of producing a fine speed control signal includes the steps of producing a periodic reference signal having a predetermined constant frequency, and comparing a periodic signal included in the information recovered from the disc with the periodic reference signal, to produce the fine speed control signal representative of the comparison.

12. A method as defined in claim 11,



wherein: said step of comparing includes the step of comparing the phase angle of the periodic signal recovered from the disc with the phase angle of the periodic reference signal; and said fine speed control signal has an average value representative of the difference in the relative phase angles of the two periodic signals.

13. A method as defined in Claims 11 or 12, wherein: the periodic signal recovered from the disc is a separate periodic pilot signal having a predetermined constant frequency.

14. A method as defined in Claims 11 or 12, wherein the information stored on the disk is video information and said periodic signal is the vertical sync signal, the horizontal sync signal, the chrominance burst signal, or a combination of two or more of the vertical sync signal, the horizontal sync signal and the chrominance burst signal of the video information.

15. A method as defined in any of Claims 11—14 wherein said step of comparing includes the step of detecting the periodic signal recovered from the disc in a phase-locked loop.

16. A method as defined in any of Claims 11—15, wherein the composite speed control signal is substantially inversely proportional to the radius of the selected information track from which information is being recovered, whereby the information storage disc is controllably rotated at an angular velocity substantially inversely proportional to the radius of the selected track and the disc is moved relative to the transducer at a substantially constant linear velocity.

17. A method as defined in any of Claims 11—15, wherein the coarse speed control signal is substantially directly proportional to the radius of the information track from which information is being recovered.

18. A method as defined in any of Claims 11—17, wherein: said step of producing the composite speed control signal includes the steps of summing together the coarse speed control signal and the fine speed control signal, to produce a composite voltage signal, and producing the composite speed control signal in a voltage-controlled oscillator, said composite speed control signal having a frequency inversely proportional to the voltage of the composite voltage signal; and the disc is rotated in said step of rotating at an angular velocity substantially directly proportional to the frequency of said composite speed control signal.

#### Revendications

1. Dispositif pour faire tourner, de façon réglable, un disque de stockage de l'information par rapport à un transducteur pour restituer l'information qui est stockée sur le disque, dans un certain nombre de pistes de l'information qui sont agencées de façon sensiblement circulaire et concentriquement,

ledit dispositif fonctionnant pour restituer l'information à une allure sensiblement constante, ledit dispositif comprenant: un moyen (130, figure 6) pour produire un signal de réglage grossier de la vitesse (141) qui varie selon le rayon de la piste particulière de l'information d'où l'information est restituée; un moyen (136) pour produire un signal de réglage précis de la vitesse (142); un moyen (140) répondant au signal de réglage grossier de la vitesse et au signal de réglage précis de la vitesse, pour produire un signal composite de réglage de la vitesse (146) représentatif de la vitesse angulaire prescrite à laquelle le disque doit tourner; et un moyen (134) répondant au signal composite de réglage de la vitesse pour faire tourner le disque à la vitesse angulaire prescrite, ainsi l'information qui y est stockée est restituée par le transducteur à l'allure constante prescrite, caractérisé en ce que ledit moyen pour produire un signal de réglage précis de la vitesse comprend un moyen (170, 172, 176) pour produire un signal périodique de référence (178) ayant une fréquence constante prédéterminée et un moyen de réglage précis de la vitesse (162) pour comparer un signal périodique (168) inclus dans l'information restituée du disque, au signal périodique de référence et pour produire ledit signal de réglage précis de la vitesse (142) représentatif de la comparaison.

2. Dispositif selon la revendication 1, où: ledit moyen de réglage précis de la vitesse comprend un moyen formant détecteur de phase (162) pour comparer les angles relatifs de phase du signal périodique restitué du disque et du signal périodique de référence; et ledit signal de réglage précis de la vitesse a une valeur moyenne représentative de la différence des angles relatifs de phase des deux signaux périodiques.

3. Dispositif selon les revendications 1 ou 2 où: le signal périodique restitué du disque est un signal pilote séparé ayant une fréquence constante prédéterminée.

4. Dispositif selon les revendications 1 ou 2 où l'information stockée sur le disque est une information vidéo et ledit signal périodique est le signal de synchronisation verticale, le signal de synchronisation horizontale, le signal de salve de chrominance ou une combinaison de deux ou plusieurs du signal de synchronisation verticale, du signal de synchronisation horizontale et du signal de salve de chrominance de l'information vidéo.

5. Dispositif selon l'une quelconque des revendications précédentes où le moyen de réglage précis de la vitesse comprend une boucle verrouillée en phase (160) pour détecter le signal périodique restitué du disque.

6. Dispositif selon l'une quelconque des revendications précédentes où le signal composite de réglage de la vitesse est sensiblement inversement proportionnel au rayon de la piste de l'information choisie d'où l'information



est restituée, ainsi le dispositif fonctionne pour faire tourner de façon réglable le disque de stockage à une vitesse angulaire qui est sensiblement inversement proportionnelle au rayon de la piste choisie et le disque se déplace par rapport au transducteur à une vitesse linéaire sensiblement constante.

7. Dispositif selon l'une quelconque des revendications 1 à 5 où le signal de réglage grossier de la vitesse est sensiblement directement proportionnel au rayon de la piste de l'information d'où l'information est restituée.

8. Dispositif selon l'une quelconque des revendications précédentes où le transducteur précité est mobile radialement par rapport au disque, pour être placé à une relation prescrite par rapport à la piste de l'information d'où l'information est restituée; et ledit moyen de réglage précis de la vitesse comprend un potentiomètre qui est couplé audit transducteur et qui est adapté à produire le signal de réglage grossier de la vitesse.

9. Dispositif selon l'une quelconque des revendications précédentes où: ledit moyen pour produire un signal composite de réglage de la vitesse comprend un moyen (140) pour additionner le signal de réglage grossier de la vitesse et le signal de réglage précis de la vitesse, pour produire un signal composite de tension et un moyen formant oscillateur réglable en tension (132), répondant au signal composite de tension, pour produire le signal composite de réglage de la vitesse, ledit signal composite de réglage de la vitesse ayant une fréquence sensiblement inversement proportionnelle au signal composite de tension, et ledit moyen pour faire tourner le disque répond à la fréquence du signal composite de réglage de la vitesse.

10. Dispositif selon l'une quelconque des revendications précédentes où le transducteur se déplace radialement par rapport au disque d'une façon continue, et l'information est restituée des pistes successives de l'information, en série.

11. Procédé pour faire tourner de façon réglable un disque de stockage de l'information par rapport à un transducteur, pour restituer l'information qui est stockée sur le disque en un certain nombre des pistes sensiblement circulaires et agencées concentriquement de l'information, où l'information est restituée du disque à une allure sensiblement constante, ledit procédé comprenant les étapes de: déterminer le rayon de la piste particulière de l'information d'où l'information est restituée par le transducteur, et produire un signal de réglage grossier de la vitesse selon celui-ci; produire un signal de réglage précis de la vitesse; produire un signal composite de réglage de la vitesse selon le signal de réglage grossier de la vitesse et le signal de réglage précis de la vitesse, ledit signal composite étant représentatif de la vitesse angulaire prescrite à laquelle le disque doit tourner; et faire tourner le disque à la

vitesse angulaire prescrite, selon le signal composite de réglage de la vitesse, ainsi l'information est restituée par le transducteur à l'allure constante prescrite, caractérisé en ce que ladite étape de produire un signal précis de réglage de la vitesse comprend les étapes de produire un signal périodique de référence avant une fréquence constante prédéterminée; et de comparer un signal périodique incorporé dans l'information restituée du disque au signal périodique de référence, pour produire le signal de réglage précis de la vitesse représentatif de la comparaison.

12. Procédé selon la revendication 11 où: ladite étape de comparer comprend l'étape de comparer l'angle de phase du signal périodique restitué du disque à l'angle de phase du signal périodique de référence; et ledit signal de réglage précis de la vitesse a une valeur moyenne représentative de la différence des angles relatifs de phase des deux signaux périodiques.

13. Procédé selon la revendications 11 ou 12 où le signal périodique restitué du disque est un signal pilote périodique séparé ayant une fréquence constante prédéterminée.

14. Procédé selon les revendications 11 ou 12 où: l'information stockée sur le disque est une information vidéo et ledit signal périodique est le signal de synchronisation verticale, le signal de synchronisation horizontale, le signal de salve de chrominance et une combinaison de deux ou plusieurs du signal de synchronisation verticale, du signal de synchronisation horizontale, et du signal de salve de chrominance de l'information vidéo.

15. Procédé selon l'une quelconque des revendications 11 à 14 où ladite étape de comparer comprend l'étape de détecter le signal périodique restitué du disque dans une boucle verrouillée en phase.

16. Procédé selon l'une des revendications 11 à 15 où le signal composite de réglage de la vitesse est sensiblement inversement proportionnel au rayon de la piste choisie de l'information d'où l'information est restituée, ainsi le disque de stockage de l'information est entraîné en rotation de façon réglable à une vitesse angulaire sensiblement inversement proportionnelle au rayon de la piste choisie et le disque est déplacé par rapport au transducteur à une vitesse linéaire sensiblement constante.

17. Procédé selon l'une quelconque des revendications 11 à 15 où le signal de réglage grossier de la vitesse est sensiblement directement proportionnel au rayon de la piste de l'information d'où l'information doit être restituée.

18. Procédé selon l'une quelconque des revendications 11 à 17 où l'étape précitée de produire le signal composite de réglage de la vitesse comprend les étapes d'additionner le signal de réglage grossier de la vitesse et le signal de réglage précis de la vitesse, pour produire un signal de tension composite, et de pro-



duire le signal composite de réglage de la vitesse dans un oscillateur réglé en tension, ledit signal composé de réglage de la vitesse avant une fréquence inversement proportionnelle à la tension du signal composite de tension; et le disque est entraîné en rotation dans ladite étape de rotation à une vitesse angulaire sensiblement directement proportionnelle à la fréquence du signal composite de réglage de la vitesse.

### Patentansprüche

1. Apparat zur Steuerung der Drehung einer Informationsspeicherplatte relativ zu einem Wandler, um Information wiederzugewinnen, die auf der Platte in einer Vielzahl von im wesentlichen kreisförmigen und konzentrisch angeordneten Informationsspuren gespeichert ist, wobei der Apparat im Betrieb die Information mit einer im wesentlichen konstanten Geschwindigkeit wiedergewinnt, welcher Apparat eine Einrichtung (130, Fig. 6) zur Erzeugung eines Geschwindigkeits-Grobregelsignals (141), das sich gemäß dem Radius der jeweiligen Informationspur ändert, von der die Information gerade gewonnen wird; eine Einrichtung (136) zur Erzeugung eines Geschwindigkeits-Feinregelsignals (142); eine auf das Geschwindigkeits-Grobregelsignal und das Geschwindigkeits-Feinregelsignal ansprechende Einrichtung (140) zur Erzeugung eines für die vorgeschriebene Winkelgeschwindigkeit, mit der die Platte zu drehen ist, repräsentativen zusammengesetzten Geschwindigkeitsregelsignals (146); und eine auf das zusammengesetzte Geschwindigkeitsregelsignal ansprechende Einrichtung (134) zum Drehen der Platte mit der vorgeschriebenen Winkelgeschwindigkeit aufweist, wodurch die darauf gespeicherte Information vom Wandler mit der vorgeschriebenen konstanten Geschwindigkeit wiedergewonnen wird, dadurch gekennzeichnet, daß die Einrichtung zur Erzeugung eines Geschwindigkeits-Feinregelsignals eine Einrichtung (170, 172, 176) zur Erzeugung eines periodischen Bezugssignals (178) mit einer vorherbestimmten konstanten Frequenz und eine Geschwindigkeits-Feinregelungseinrichtung (162) zum Vergleich eines in der von der Platte wiedergewonnenen Information enthaltenen periodischen Signals (168) mit dem periodischen Bezugssignal und zur Erzeugung des für den Vergleich repräsentativen Geschwindigkeits-Feinregelsignals (142) aufweist.

2. Apparat nach Anspruch 1, dadurch gekennzeichnet, daß die Geschwindigkeits-Feinregelungseinrichtung eine Phasendetektor (162) Einrichtung zum Vergleich der relativen Phasenwinkel des von der Platte wiedergewonnenen periodischen Signals und des periodischen Bezugssignals aufweist; und das Geschwindigkeits-Feinregelsignal einen für die Differenz in den relativen Phasenwinkeln der

zwei periodischen Signale repräsentativen Mittelwert hat.

3. Apparat nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das von der Platte wiedergewonnene periodische Signal ein gesondertes Pilotsignal mit einer vorherbestimmten konstanten Frequenz ist.

4. Apparat nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die auf der Platte gespeicherte Information Videoinformation ist, und das periodische Signal das Vertikalsynchronsignal, das Horizontalsynchronsignal, das Farbart-Burstsignal oder eine Kombination von zwei oder mehreren von den Vertikalsynchron-, Horizontalsynchron- und Farbart-Burstsignalen der Videoinformation ist.

5. Apparat nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Geschwindigkeits-Feinregelungseinrichtung eine phasenverriegelte Schleife (160) zur Detektion des von der Platte wiedergewonnenen periodischen Signals aufweist.

6. Apparat nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das zusammengesetzte Geschwindigkeitsregelsignal im wesentlichen umgekehrt proportional zum Radius der ausgewählten Informationspur ist, von der gerade Information wiedergewonnen wird, wodurch der Apparat im Betrieb die Drehung der Speicherplatte mit einer Winkelgeschwindigkeit steuert, die im wesentlichen umgekehrt proportional zum Radius der ausgewählten Spur ist, und die Platte relativ zum Wandler mit einer im wesentlichen konstanten linearen Geschwindigkeit bewegt wird.

7. Apparat nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß das Geschwindigkeits-Grobregelsignal im wesentlichen direkt proportional zum Radius der Informationsspur ist, von der gerade Information wiedergewonnen wird.

8. Apparat nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß der Wandler relativ zur Platte radial bewegbar ist, um in einem vorgeschriebenen Verhältnis relativ zu der Informationsspur, von der gerade Information wiedergewonnen wird, in Position gebracht zu werden; und die Geschwindigkeits-Grobregelungseinrichtung ein Potentiometer aufweist, das mit dem Wandler gekoppelt ist, und das zur Erzeugung des Geschwindigkeits-Grobregelsignals geeignet ist.

9. Apparat nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Einrichtung zur Erzeugung eines zusammengesetzten Geschwindigkeitsregelsignals einer Einrichtung (140) zum Summieren des Geschwindigkeits-Grobregelsignals und des Geschwindigkeits-Feinregelsignals, zur Erzeugung eines zusammengesetzten Spannungssignals, und eine auf das zusammengesetzte Spannungssignal ansprechende spannungsgesteuerte Oszillatoreinrichtung (132) zur Erzeugung des Zusammengesetzten Gesch-



windigkeitsregelsignals aufweist, wobei das zusammengesetzte Geschwindigkeitsregelsignal eine Frequenz hat, die im wesentlichen umgekehrt proportional zum zusammengesetzten Spannungssignal ist; und die Einrichtung zum Drehen der Platte auf die Frequenz des zusammengesetzten Geschwindigkeitsregelsignals anspricht.

10. Apparat nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß der Wandler relativ zur Platte in kontinuierlicher Weise radial bewegt wird, und die Information von den aufeinander folgenden Informationsspuren der Reihe nach wiedergewonnen wird.

11. Verfahren zur Steuerung der Drehung einer Informationsspeicherplatte relativ zu einem Wandler, um Information wiederzugewinnen, die auf der Platte in einer Vielzahl von im wesentlichen kreisförmigen und konzentrisch angeordneten Informationsspuren gespeichert ist, wobei die Information mit einer im wesentlichen konstanten Geschwindigkeit von der Platte wiedergewonnen wird, welches Verfahren die Schritte aufweist, daß: der Radius der jeweiligen Informationsspur bestimmt wird, von der mit dem Wandler gerade Information wiedergewonnen wird, und ein Geschwindigkeits-Grobregelsignal in Entsprechung dazu erzeugt wird; ein Geschwindigkeits-Feinregelsignal erzeugt wird; ein zusammengesetztes Geschwindigkeitsregelsignal entsprechend dem Geschwindigkeits-Grobregelsignal und dem Geschwindigkeits-Feinregelsignal erzeugt wird, wobei das zusammengesetzte Signal für die vorgeschriebene Winkelgeschwindigkeit, mit der die Platte zu drehen ist, repräsentativ ist; und die Platte mit der vorgeschriebenen Winkelgeschwindigkeit, entsprechend dem zusammengesetzten Geschwindigkeitsregelsignal, gedreht wird, wodurch die Information vom Wandler mit der vorgeschriebenen konstanten Geschwindigkeit wiedergewonnen wird, dadurch gekennzeichnet, daß der Schritt der Erzeugung eines Geschwindigkeits-Feinregelsignals die Schritte umfaßt, daß ein periodisches Bezugssignal, das eine vorherbestimmte konstante Frequenz hat, erzeugt und ein in der von der Platte wiedergewonnenen Information enthaltenes periodisches Signal mit dem periodischen Bezugssignal verglichen wird, um das für den Vergleich repräsentative Geschwindigkeits-Feinregelsignal zu erzeugen.

12. Verfahren nach Anspruch 11, dadurch gekennzeichnet, daß der Vergleichsschritt den Schritt beinhaltet, daß der Phasenwinkel des von der Platte wiedergewonnenen periodischen Signals mit dem Phasenwinkel des periodischen Bezugssignals verglichen wird; und das Geschwindigkeits-Feinregelsignal einen für die Differenz in den relativen Phasenwinkeln der

zwei periodischen Signale repräsentativen Mittelwert hat.

13. Verfahren nach Anspruch 11 oder 12, dadurch gekennzeichnet, daß das von der Platte wiedergewonnene periodische Signal ein gesondertes periodisches Pilotsignal mit einer vorherbestimmten konstanten Frequenz ist.

14. Verfahren nach Anspruch 11 oder 12, dadurch gekennzeichnet, daß die auf der Platte gespeicherte Information Videoinformation ist, und das periodische Signal das Vertikalsynchronsignal, das Horizontalsynchronsignal, das Farbart-Burstsignal oder eine Kombination von zwei oder mehreren von den Vertikalsynchron-, Horizontalsynchron- und Farbart-Burstsignalen der Videoinformation ist.

15. Verfahren nach einem der Ansprüche 11—14, dadurch gekennzeichnet, daß der Vergleichsschritt den Schritt beinhaltet, daß das von der Platte wiedergewonnene periodische Signal in einer phasenverriegelten Schleife detektiert wird.

16. Verfahren nach einem der Ansprüche 11—15, dadurch gekennzeichnet, daß das zusammengesetzte Geschwindigkeitsregelsignal im wesentlichen umgekehrt proportional zum Radius der ausgewählten Informationsspur ist, von der gerade Information wiedergewonnen wird, wodurch die Informationsspeicherplatte unter Steuerung mit einer Winkelgeschwindigkeit gedreht wird, die im wesentlichen umgekehrt proportional zum Radius der ausgewählten Spur ist, und die Platte relativ zum Wandler mit einer im wesentlichen konstanten linearen Geschwindigkeit bewegt wird.

17. Verfahren nach einem der Ansprüche 11—15, dadurch gekennzeichnet, daß das Geschwindigkeits-Grobregelsignal im wesentlichen direkt proportional zum Radius der Informationsspur ist, von der gerade Information wiedergewonnen wird.

18. Verfahren nach einem der Ansprüche 11—17, dadurch gekennzeichnet, daß der Schritt der Erzeugung des zusammengesetzten Geschwindigkeitsregelsignals die Schritte beinhaltet, daß das Geschwindigkeits-Grobregelsignal und das Geschwindigkeits-Feinregelsignal summiert werden, um ein zusammengesetztes Spannungssignal zu erzeugen, und das zusammengesetzte Geschwindigkeitsregelsignal in einem spannungsgesteuerten Oszillator erzeugt wird, wobei das zusammengesetzte Geschwindigkeitsregelsignal eine Frequenz hat, die umgekehrt proportional zur Spannung des zusammengesetzten Spannungssignals ist; und die Platte beim Drehen mit einer Winkelgeschwindigkeit gedreht wird, die im wesentlichen direkt proportional zur Frequenz des zusammengesetzten Geschwindigkeitsregelsignals ist.

