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(54) **Method and apparatus for controlling the reading of information from an information storage medium.**

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Method and apparatus for controlling the reading of information from an information storage medium

This invention relates generally to information recording systems and, more particularly, to servo apparatus for moving an information storage medium such as a disc, cylinder, or tape, relative to a device for recovering information therefrom.

An example of a servo apparatus of this particular type employs a spindle motor for rotating a disc-shaped record carrier and a tachometer coupled to the spindle motor for producing a signal representative of its angular velocity. The servo apparatus is operable to lock the phase of the tachometer signal onto the phase of a locally generated reference signal.

The above system has not proven completely satisfactory, however, because the angular velocity of the spindle motor does not necessarily correlate precisely with the angular velocity of the record carrier relative to the information recovery device. Eccentricities in the shape of the record carrier and vibrations brought about by the relative movement cause undesired variations in the relative velocity of the particular information track being read. Moreover, the signal produced by the tachometer does not necessarily correlate precisely with the angular velocity of the motor, because of eccentricities and other defects in the tachometer, itself. Still another drawback to a system of this type arises because the cost of the tachometer and the manufacturing costs for mounting it are relatively high. An information storage disc is also known from the German patent 2 521 821, which stores information including periodic signals to be compared with reference signals for producing a control voltage controlling the speed of the disc.

It will be appreciated from the foregoing that there is still a need for apparatus for precisely controlling the velocity of a record medium relative to a device for receiving information therefrom, which is operable even when the recovery device is not critically positioned with respect to an individual information track or is traversing the record medium from one track to another and which can do so without undue complexity or cost. An object of the present invention is to fulfill this need.

Basically, the invention resides in an improved apparatus and method for controlling the reading of information on the storage medium for example by controlling the speed of relative movement between the medium and a reader. Preferably, the storage medium includes a plurality of substantially parallel information tracks, each of such tracks bearing information that includes a pilot signal having a predetermined frequency. The servo apparatus is operable to synchronise the pilot signals reproduced by the information recovery device with a local reference signal having a frequency that corresponds to the desired relative velocity of the storage medium.

In accordance with the invention, the phase angle of the pilot signals recorded on the storage medium is aligned with itself on adjacent information tracks, whereby the servo apparatus can continue to control the relative velocity of the storage medium, even when the information recovery device is traversing the record medium from one track to another or is otherwise not critically positioned with respect to an individual information track. The invention also provides an information recovery apparatus having the features defined in claim 12.

More particularly, a servo apparatus constructed in accordance with the present invention is especially adaptable for use with an optically readable disc-shaped record carrier having a plurality of substantially parallel information tracks arranged in a spiral or in concentric circles. Recorded on the disc is a composite signal, which includes a summation of the pilot signals and other information preferably frequency modulated on a carrier. The composite signal is represented on the information tracks by a series of bumps and lands, and the frequency of the pilot signals is preferably substantially lower than that of the frequency modulated carrier. The pilot signals therefore effectively cause the duty cycle of the bumps and lands to vary above and below an average value, in a periodic fashion. As a result, the phase alignment of the pilot signals has the effect of creating a group of spaced radial "spokes" each spoke corresponding to a region where the duty cycle of the recorded composite signal exceeds its average value.

The servo apparatus may include a bandpass filter for separating the pilot signals from the remainder of the composite signal recovered from the record disc, followed by a phase-locked loop to remove unwanted noise and eliminate the occurrence of any signal dropout. A phase and frequency detector compares the output of the phase-locked loop to the local reference signal, which has a frequency representative of the desired angular velocity for the disc, thereby producing an error signal that is utilised to drive a spindle motor for rotating the disc. The apparatus can further include means for reducing the bandwidth of the bandpass filter, thereby increasing the signal-to-noise ratio of the separated pilot signal, whenever it is determined that the angular velocity of the disc is within a predetermined range of the desired velocity.

The servo apparatus can include a supplementary control loop for use in effecting a coarse control of the speed of the spindle motor during initial startup. The separate control loop includes means for continuously measuring both the voltage applied to the terminals of the spindle motor and the current drawn by the

motor, and for utilising these measurements to compute the "back emf" of the motor. A differential amplifier is then employed to compare this computed value to a predetermined reference voltage, and thereby produce an error signal for driving the motor. After the motor has achieved a predetermined angular velocity, a switch is actuated to initiate operation of the pilot signal control loop earlier described.

The pilot signal recovered from the record medium can be used in apparatus for correcting time base errors that inevitably occur in the signal reproduced from the storage medium. These errors are commonly created by vibrations and eccentricities, or other defects, in the record medium. In this manner, time base errors can be corrected for even though the information recovery device may not be in proper alignment with an individual information track.

The pilot signal recovered from the record medium can also be used in combination with a system for acquiring focus. In such a focusing system, a lens positioned over a record disc is initially retracted and then moved toward the disc in a linear fashion until focus is achieved. In accordance with one aspect of the present invention, the distance over which the lens need be moved can be reduced by limiting it to positions in which the pilot signal can be detected, any additional movement necessarily being in positions where proper focus could not be achieved. This substantially reduces the time period needed for initial acquisition of proper focus.

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 block diagram of a servo apparatus in accordance with the present invention, for controlling the angular velocity of a disc-shaped record medium;

FIGURE 2 is a timing diagram (not necessarily to scale) showing a portion of a composite signal, which includes a pilot signal additively combined with a carrier signal, to be recorded on the disc, and showing the corresponding arrangement of bumps and lands formed on the disc; and

FIGURE 3 is a simplified perspective view of the record disc, showing a plurality of spaced radial spokes, which represent the periodic variations in the duty cycle of the composite signal recorded thereon.

Description of the Preferred Embodiment

Referring now to the drawings, and particularly to Figure 1, there is shown a servo apparatus for controlling the angular velocity of a disc-shaped record carrier 11 relative to a device 13 for recovering information recorded thereon. The information is recorded on the disc 11 on a series of substantially parallel information tracks 15 (Fig. 3) arranged in either a spiral or concentric circle pattern, and can include, for example, a conventional color television signal frequency on a carrier, along with a pilot signal having a predetermined, constant frequency substantially lower than that of the modulated carrier. The servo apparatus operates to vary the angular velocity of a spindle motor 17 that rotates the disc 11 by synchronizing the frequency and phase angle of the pilot signal recovered from the disc with the frequency and phase angle of a locally generated reference signal having a frequency that corresponds to the desired angular velocity for the disc.

In accordance with the invention, the pilot signal recorded on the disc 11 includes the same integral number of cycles on each information track 15 whereby the phase angle of the pilot signal is aligned on adjacent tracks and the servo apparatus can continue to properly control the angular velocity of the disc even when the information recovery device 13 is not critically positioned with respect to an individual information track or is traversing the disc from one track to another.

In the preferred embodiment, the frequency modulated carrier signal is additively combined with the lower frequency pilot signal to form a composite signal for recording on the disc 11. Figure 2 depicts a portion of this composite signal (not to scale), along with a corresponding arrangement of optically readable bumps 19 and lands 21 representing the signal as it is actually encoded on the disc.

It will be appreciated from Figure 2 that the bumps 19 occur wherever the instantaneous composite signal exceeds a predetermined threshold. Selection of a threshold corresponding to the D.C. level of the signal will result in a nominal duty cycle of the recorded pattern of bumps and lands being 50 percent. It will be observed that the pilot signal will appear in the recorded pattern as a periodic variation in the duty cycle of the bumps 19 and lands 21. Positive portions of the pilot signal will result in a duty cycle that exceeds 50 percent, and negative portions of the pilot signal will result in the duty cycle that is less than 50 percent. In the preferred embodiment, the pilot signal has a magnitude approximately 35 db lower than that of the frequency modulated carrier signal and also has a substantially lower frequency, so as to reduce any interference with the modulated signal. Accordingly, it will be appreciated that the duty cycle variations above and below 50 percent will be slight.

When the carrier signal is being modulated by a conventional television signal, it is desirable that each information track 15, i.e., each revolution of the disc 11 contain the

information for one video frame. Accordingly, for proper reproduction of the signal, the disc must be rotated at an angular velocity of about 1800 rpm. Use of a pilot signal having a frequency of about 400 KHz, then, results in approximately 13000 cycles of the pilot signal being recorded on each track 15.

As depicted in Figure 3, the cycles of the pilot signal, which are aligned with each other on adjacent information tracks 15, will appear as spaced radial spokes 23 on the disc 11. Each of the spokes corresponds to a portion of the pilot signal having a duty cycle greater than 50 percent, and the regions between the spokes correspond to the portions of the pilot signal having a duty cycle less than 50 percent. The successive bumps 19 and lands 21 are preferably adapted to be alternately light reflective and light non-reflective, whereby they can be properly detected by means of a laser beam, shown diagrammatically in FIG. 1 by a dotted line 25. When the laser beam is properly focused, it will impinge on a portion of the disc 11 having a diameter approximately equivalent to the width of an individual information track 15, and as the disc is rotated with respect thereto, a modulated reflected laser beam that corresponds to the recorded information will be produced.

On the other hand, when the laser beam 25 is not properly focused on the disc 11, a plurality of information tracks 15 will be illuminated simultaneously and the reflected laser beam will have an intensity that is modulated by the information recorded on all of those illuminated tracks. As a result, proper frequency demodulation of the modulated carrier signal cannot generally be achieved.

The pilot signal, however, which is added to the frequency modulated carrier on each information track 15, has a phase angle that is aligned for all of the tracks illuminated. Accordingly, the intensity of the reflected laser beam 25 will be properly modulated by the pilot signal, even though the reflected beam is modulated by information recorded on a plurality of information tracks. The angular velocity of the disc 11 relative to the information recovery device 13 can therefore be precisely controlled, even though the laser beam of the device is not properly focused on an individual information track. Only when the laser beam is improperly focused to the extent that the portion of the disc illuminated has a size approaching the length of one cycle of the pilot signal, will the apparatus be unable to properly detect the pilot signal.

The servo apparatus of the present invention is also operable to control the angular velocity of the disc 11 when the information recovery device 13 is traversing the information tracks 15 of the disc in a rapid fashion, as, for example, when searching for a predetermined individual track. Since the phase angle of the pilot signal is in alignment on adjacent information tracks, the pilot signal reproduced by the information recovery device will not experience any substantial phase discontinuities during a traversing of the disc, and the servo apparatus will therefore maintain the recovered pilot signal properly phase-locked to the local reference signal.

Referring again to FIG. 1, the servo apparatus of the present invention includes a conventional wide band-pass filter 27, which receives on line 28 the signal reproduced by the information recovery device 13, and which then separates the pilot signal from the frequency modulated carrier signal. This is followed by a conventional phase-locked loop 29 for removing additional noise from the filtered pilot signal and for eliminating signal dropouts that can sometimes occur. The output of the phase-locked loop, which has a substantially constant amplitude and a frequency that corresponds to the angular velocity of the disc 11, is transmitted over line 30 to a divide-by-100 circuit 31.

The apparatus further includes a conventional 3.58 MHz oscillator 33 and a divide-by-910 circuit 35 for producing the aforementioned local reference signal, and a phase and frequency detector circuit 37 for comparing the local reference signal to the output of the divide-by-100 circuit 31 (i.e., the processed pilot signal recovered from the disc 11). The detector 37 produces an analog voltage signal that is proportional to the difference between the phase angles of the two signals, which are supplied to the detector over lines 39 and 41, respectively.

Additionally, the detector circuit 37 is operable to detect differences in the frequencies of the respective signals, and the level of the analog voltage signal is modified, accordingly. This ensures that the servo apparatus will not lock the frequency of the recovered pilot signal onto a multiple or sub-multiple of the frequency of the reference signal. An example of a suitable phase and frequency detector is disclosed in an article entitled "Digital Control of Shaft Speed and Position", appearing in *IEEE Spectrum*, January 1968, pp. 90—95.

The analog output signal of the phase and frequency detector 37 is transmitted over line 43 to a loop compensation circuit 45, which provides the servo apparatus with a desired loop gain and bandwidth. The output of this compensation circuit 45 is transmitted over line 47 to a loop switch 49, and, in turn, over line 51 to a motor driver 53, which drives the spindle motor 17, accordingly.

In accordance with one aspect of the present invention, the servo apparatus can further include a narrow band-pass filter 55 for use in increasing the signal-to-noise ratio of the reproduced pilot signal when the spindle motor 17 is operating at an angular velocity very near the desired velocity. The narrow band-pass filter 55 is connected in series with the wide band-pass filter 27, receiving the output of the wide

band-pass filter on line 57 and producing a filtered signal for output on line 59.

A summer 61 is included for summing the respective output signals of the wide band-pass filter 27 and the narrow band-pass filter 55, supplied over lines 57 and 59 respectively. Additionally, an amplitude detector 63 is included for determining when the output of the narrow band-pass filter exceeds a predetermined threshold, which indicates that the angular velocity of the disc 11 is close to its desired level. The detector 63 then opens a switch 65 to prevent the output signal of the wide band-pass filter from being summed by the summer. In the preferred embodiment, which is utilized with a pilot signal having a frequency of about 400 KHz, the wide band-pass filter has a bandwidth of approximately 120 KHz and the narrow band-pass filter has a bandwidth of approximately 10 KHz.

In another aspect of the invention, the servo apparatus includes a separate control loop 67 for use in achieving a coarse control of the angular velocity of the spindle motor 17 during initial startup of the record disc 11. This control loop functions to produce a predetermined back-emf in the spindle motor that corresponds to the desired angular velocity of the disc.

The back-emf control loop 67 includes a back-emf measurement circuit 69 which continuously monitors both the analog voltage and the analog current produced by the motor driver 53 and supplied to the spindle motor 17 and, using conventional techniques, computes the back-emf of the motor. A differential amplifier 71 is utilized to compare the computed back-emf voltage, supplied on line 73 from the emf circuit 69, to a predetermined selected reference voltage, supplied on line 75, and to produce a corresponding analog voltage for transmission over line 77 to the motor driver.

Operation of the back-emf control loop 67 is initiated upon receipt of a "RUN" control signal, transmitted on line 79 to the differential amplifier 71. After the emf control loop has operated alone for sufficient duration to bring the angular velocity of the record disc 11 to within a predetermined range of the desired velocity, a pilot loop control signal is transmitted over line 81 to the loop switch 49 to initiate operation of the control loop that utilises the pilot signal. Both the "back-emf" loop and the pilot signal loop are then operable simultaneously, but the "loop gain" of the pilot signal loop is substantially greater, so the effect of the "back-emf" loop is minimal.

It will be appreciated that the pilot loop control signal supplied over line 81 for initiating operation of the pilot signal control loop can be generated in many ways. For example, it can be produced whenever the frequency modulated carrier signal reproduced by the information recovery device 13 is being properly demodulated, or, alternatively, whenever the pilot signal appears at the output of the wide band-pass filter 27. In either case, the signal occurs only when the frequency of the recovered pilot signal is near its desired level.

Thus, as shown in FIGURE 1, the pilot loop control signal is generated by a pilot loop control signal circuit (not shown), which monitors either the signal output by the information recovery device 13, or the signal output by the wide band pass filter 27.

The pilot signal recovered from the record medium can also be utilised in a time base error correction apparatus (not shown), which operates to compensate for timing variations in the reproduced signals, due to such factors as vibrations and eccentricities in the record medium. Such apparatus includes means for variably delaying a video signal recovered by an information recovery device from a record carrier, to correct for time base variations detected therein. The amount by which the video signal is delayed is determined by differences in the phase angles of a local reference signal having a predetermined constant frequency and a pilot signal recovered from the record carrier.

In accordance with one aspect of the present invention, a time base correction apparatus of the general type can be utilized in combination with a record medium having a plurality of substantially parallel information tracks on which a pilot signal is recorded, with the phase angle of the recorded pilot signal in alignment with itself on adjacent tracks. As a result, time base variations in the information recovered from the record medium can be readily corrected for, even through the information recovery device may be traversing the record medium from one information track to another or otherwise may not be precisely aligned with an individual track, since the pilot signal can still be detected in those situations.

In accordance with still another aspect of the present invention, the pilot signal reproduced from the record disc 11 can be utilized in a focus servo apparatus. In the focus servo apparatus, a lens is positioned over a record disc for focusing a laser beam on an individual information track thereon. Initial focus is achieved by first retracting the lens fully, and then moving it toward the disc in a linear fashion, until it is determined that the proper lens position has been reached.

When the lens is fully retracted, it may be operating to illuminate a portion of the record disc 11 of such size that even the pilot signal cannot be detected (i.e. the illuminated disc region has a size greater than approximately one cycle of the pilot signal on the disc). In accordance with the invention, the time required to properly focus the lens is reduced by initially retracting the lens only as far as the pilot signal is still being detected, and initiating the linear movement of the lens toward the disc at that location. This prevents the apparatus for

attempting to acquire focus for a range of lens locations in which proper focus cannot possibly be attained.

From the foregoing description, it should be apparent that the present invention provides an effective apparatus for controlling the angular velocity of a record disc relative to a read head of an information recovery device, operable even when the read head is not critically positioned with respect to an individual information track on the disc or is traversing the disc from one track to another. Moreover, this velocity control is achieved without the need for a relatively costly tachometer.

Prior proposals by the present Applicants are the subject of Europan Patent Applications Nos. 79300487.0, 79300489.6 and 79300490.4 (Publication Nos. 0004476, 0004738 and 0005316) falling within the terms of Art. 54(3).

Claims

1. An information storage medium having an information track arranged in a number of spiral turns or in concentric circular turns, the information track carrying pilot signals included in the information, the phase angle of the pilot signals being aligned with itself on adjacent turns.

2. A medium as claimed in Claim 1 in which the pilot signals are at a constant frequency substantially less than a substantial portion of the frequency components of the information.

3. A medium as claimed in Claim 1 or Claim 2 in the form of a disc, the pilot signal portion of the recorded information including an integral number of cycles on each turn of the track.

4. A medium as claimed in any of Claims 1—3 wherein the information signal portion of the recorded information is a modulated carrier, the recording medium is a light-reflective disc and each turn of the information track therein includes a sequence of spaced regions of non-reflectivity, and the duty cycle of the recorded pattern of the regions of non-reflectivity varies in accordance with the phase of the pilot signal.

5. A method of reading information from an information track arranged in a number of spiral, or concentric circular, turns on a storage medium, the track also carrying pilot signals aligned in phase radially on the turns, in which method the pilot signals are extracted from the information read and are used to control the reading operation.

6. A method as claimed in Claim 5 in which the information and pilot signals are in the form of frequency modulation of a carrier frequency, in which the carrier is demodulated, and the motor speed is not controlled while the actual motor speed differs from a desired speed by more than a predetermined amount, and/or while the carrier is not being properly modulated, and/or while the pilot signals are not being separated from the information.

7. A method as claimed in Claim 5 or Claim 6 in which a reference signal having a frequency representative of the desired speed of movement of the medium in relation to the recovery means, is generated, and its phase is compared with the phase of the extracted pilot signals, and produces a driver signal for controlling the speed of the storage medium.

8. A method as claimed in any of Claims 5—7 in which the speed of the medium is only controlled while pilot signals are being recovered and not while other information is being recovered.

9. A method as claimed in any of Claims 5—8 operating while a reader of the information and pilot signals is not centrally aligned on the track, or when it is moving from one turn of the track to another.

10. A method as claimed in any of Claims 5—9 in which a first motor driver signal is derived from a comparison of the phase of the reference signal with the pilot signal, the back-emf developed by a motor for driving the medium is measured and compared with a predetermined level to produce a second motor driver signal, and a control signal is produced when the difference between the speed of the medium and the desired speed exceeds a predetermined threshold, and in response to that control signal, the first motor driver signal is prevented from adjusting the speed of the medium.

11. A method as claimed in any of Claims 5—10, in which information is recovered from the medium by a beam of radiation focused on the medium by a lens having means for detecting when the beam is focused on the track, and in which in a focusing step the lens is first retracted to an initial position defined by the location at which the pilot signal is not detected, and then is moved in relation to the medium until it is detected that focus has been achieved.

12. Information recovery apparatus including a motor for providing relative rotation between an information storage medium as claimed in any of Claims 1—4, and a reader of information and pilot signals stored on the medium, means arranged to extract pilot signals from information read by the reader, and a control responsive to the pilot signals, and arranged to control the motor, and/or the reader.

13. Apparatus as claimed in Claim 12 including means for producing a reference signal representative of the desired speed of the medium, a filter for extracting the pilot signals from the information on the track, and a comparator comparing the phase of the reference signal with that of the pilot signals to produce a first motor driver signal for controlling a motor driving the medium.

14. Apparatus as claimed in Claim 13 in which the filter includes a wide band-pass filter, and a narrow band-pass filter, the bandwidth of the narrow band-pass filter being smaller than the bandwidth of the wide band-pass filter, a

phase-locked loop arranged to receive the outputs of the wide band-pass filter and the narrow band-pass filter to produce a filtered pilot signal, and an amplitude detector arranged to uncouple the output of the wide band-pass filter from the phase-locked loop whenever it is determined that the recovered pilot signal is at the output of the narrow band-pass filter.

15. Apparatus as claimed in any of Claims 12—13 including means for measuring the back-emf developed by the motor for driving the medium, means for comparing the measured back-emf with a predetermined level for producing a second driver signal to adjust the speed of the motor, and means responsive to the difference between the actual and the desired speeds of the motor exceeding a predetermined threshold for preventing the first motor driver signal from adjusting the motor speed.

16. Apparatus as claimed in any of Claims 12—15 including delay means responsive to the recovered pilot signal and to the reference signal for delaying the recovered information by an amount that varies in accordance with any difference in the phase of the two signals.

17. Apparatus as claimed in any of Claims 12—16 including a demodulator of frequency modulation of a carrier frequency constituting information on the storage medium and means for preventing control of the motor speed in response to a detector that the carrier frequency is not being demodulated, and/or in response means for detecting that the actual motor speed differs from the desired speed by more than a predetermined amount, and/or in response to means detecting that the pilot signals are not being separated from the information.

18. Apparatus as claimed in any of Claims 12—17 including a lens for directing a beam of reading radiation at the storage medium, and means for detecting when the beam is focused on a turn of the track, means for initially retracting the lens to an initial position, and means operable after the lens has been retracted to the initial position to move the lens in relation to the storage medium until focused detecting means detects that focus on the selected turn of the track has been achieved, the initial position of the lens being defined by the location at which the pilot signal is no longer detected by the scanning means.

Revendications

1. Porteur d'enregistrement d'informations comportant une piste d'informations agencée en un certain nombre de spires en spirale ou en spires circulaires concentriques, la piste d'informations portant des signaux pilotes inclus dans les informations, l'angle de phase des signaux pilotes étant aligné avec lui-même sur des spires voisines.

2. Porteur selon la revendication 1, dans lequel les signaux pilote ont une fréquence constante, nettement inférieure à une partie substantielle des composantes de fréquence des informations.

3. Porteur selon la revendication 1 ou la revendication 2, sous la forme d'un disque, la partie du signal pilote des informations enregistrées comprenant un nombre entier de cycles sur chaque spire de la piste.

4. Porteur selon l'une quelconque des revendications 1—3, dans lequel la partie du signal d'informations des informations enregistrées est une porteuse modulée, le porteur d'enregistrement est un disque réfléchissant la lumière et chaque spire de piste d'informations contient une séquence de régions espacées non réfléchissantes et le rapport d'impulsions du profil enregistré des régions non réfléchissantes varie en fonction de la phase du signal pilote.

5. Procédé de lecture d'informations dans une piste d'informations disposée en un certain nombre de spires en spirale ou circulaires concentriques sur un porteur d'enregistrement, la piste portant également des signaux pilotes alignés radialement en phase sur les spires, procédé dans lequel les signaux pilotes sont extraits de la lecture d'information et sont utilisés pour contrôler l'opération de lecture.

6. Procédé selon la revendication 5, dans lequel les informations et les signaux pilotes sont sous la forme d'une modulation de fréquence d'une fréquence porteuse, dans lequel la porteuse est démodulée, et la vitesse du moteur n'est pas contrôlée pendant que la vitesse réelle du moteur diffère d'une vitesse désirée de plus d'une valeur prédéterminée, et/ou pendant que la porteuse n'est pas modulée correctement, et/ou pendant que les signaux pilotes ne sont pas séparés des informations.

7. Procédé selon la revendication 5 ou la revendication 6, dans lequel un signal de référence ayant une fréquence représentative de la vitesse désirée du mouvement du porteur par rapport au dispositif de restitution est produit, et sa phase est comparée avec la phase des signaux pilotes extraits, et produisant un signal d'attaque pour commander la vitesse du porteur d'enregistrement.

8. Procédé selon l'une quelconque des revendications 5—7, dans lequel la vitesse du porteur n'est commandée que pendant que des signaux pilotes sont restitués et non pendant que d'autres informations sont restituées.

9. Procédé selon l'une quelconque des revendications 5—8, fonctionnant pendant qu'un lecteur des informations et des signaux pilotes n'est pas aligné centralement sur la piste ou lorsqu'il se déplace d'une spire de la piste à une autre.

10. Procédé selon l'une quelconque des revendications 5—9, dans lequel un premier signal d'attaque le moteur est produit à partir d'une comparaison de la phase du signal de référence avec le signal pilote, la force contre-

électromotrice développée par un moteur pour entraîner le porteur étant mesurée et comparée avec une valeur prédéterminée pour produire un second signal d'attaque de moteur, et un signal de commande est produit quand la différence entre la vitesse du porteur et la vitesse voulue dépasse un seuil prédéterminé, et, en répose à ce signal de commande, il est interdit au premier signal d'attaque de moteur de régler la vitesse du porteur.

11. Procédé selon l'une quelconque des revendications 5—10, dans lequel des informations sont restituées à partir du porteur au moyen d'un faisceau de rayonnement focalisé sur le porteur par une lentille, comprenant un dispositif pour détecter si le faisceau est focalisé sur la piste et dans lequel dans une phase de focalisation, la lentille est d'abord retractée dans une position initiale définie par la position dans laquelle le signal pilote n'est pas détecté puis elle est déplacée par rapport au porteur jusqu'à ce qu'il soit détecté que la focalisation a été obtenue.

12. Appareil de restitution d'informations comprenant un moteur pour produire une rotation relative entre un porteur d'enregistrement d'informations revendiqué dans l'une quelconque des revendications 1 à 4, et un lecteur d'informations, et des signaux pilotes enregistrés sur le porteur, un dispositif agencé pour extraire des signaux pilotes de l'information lue par le lecteur et une commande réagissant aux signaux pilotes, et agencé pour commander le moteur et/ou le lecteur.

13. Appareil selon la revendication 12, comprenant un dispositif pour produire un signal de référence représentatif de la vitesse désirée du porteur, un filtre pour extraire les signaux pilotes des informations sur la piste et un comparateur comparant la phase du signal de référence avec celle des signaux pilotes pour produire un premier signal d'attaque de moteur qui commande un moteur entraînant le porteur.

14. Appareil selon la revendication 13, dans lequel le filtre comporte un filtre passe-bande large et un filtre passe-bande étroite, la largeur de bande du filtre passe-band étroite étant inférieure à la largeur de bande du filtre passe-bande large, une boucle à verrouillage de phase agencée pour recevoir les sorties du filtre passe-bande large et du filtre passe-bande étroite pour produire un signal de pilote filtré et un détecteur d'amplitude agencé pour découpler la sortie du filtre passe-bande large de la boucle à verrouillage de phase lorsqu'il est déterminé que le signal pilote restitué se trouve à la sortie du filtre passe-bande étroite.

15. Appareil selon l'une quelconque des revendications 12—13, comprenant un dispositif pour mesurer la force contre-électromotrice développée par le moteur d'entraînement du porteur, un dispositif pour comparer la force contre-électromotrice mesurée avec un niveau prédéterminé, pour produire un second signal d'attaque afin de régler la vitesse du moteur et un dispositif réagissant à la différence entre les vitesses réelle et désirée du moteur dépassant un seuil prédéterminé pour empêcher que le premier signal d'attaque de moteur règle la vitesse du moteur.

16. Appareil selon l'une quelconque des revendications 12—15, comprenant un dispositif à retard réagissant au signal pilote restitué et au signal de référence en retardant les informations restituées d'une valeur qui varie en fonction d'une différence de la phase des deux signaux.

17. Appareil selon l'une quelconque des revendications 12—16, comprenant un démodulateur de modulation de fréquence d'une fréquence porteuse constituant des informations sur le porteur d'enregistrement et un dispositif pour interdire la commande de la vitesse du moteur en réponse à un détecteur que la fréquence porteuse n'est pas démodulée, et/ou en réponse à un dispositif de détection que la vitesse réelle du moteur diffère de la vitesse désirée de plus d'une valeur prédéterminée et/ou en réponse à un dispositif qui détecte que les signaux pilotes ne sont pas séparés des informations.

18. Appareil selon l'une quelconque des revendications 12—17, comprenant une lentille pour diriger un faisceau de rayonnement de lecture sur le porteur d'enregistrement et un dispositif détectant si le faisceau est focalisé sur une spire de la piste, un dispositif pour rétracter initialement la lentille dans une position initiale et un dispositif qui, après que la lentille a été rétractée dans la position initiale, fonctionne pour déplacer la lentille par rapport au porteur d'enregistrement jusqu'à ce qu'un dispositif de détection focalisé détecte que la focalisation sur la spire sélectionnée de la piste a été obtenue, la position initiale de la lentille étant définie par la position dans laquelle le signal pilote n'est plus détecté par le dispositif d'exploration.

Patentansprüche

1. Informationsspeichermedium mit einer Informationsspur, die in einer Anzahl von spiralförmigen Gängen oder in konzentrischen kreisförmigen Gängen angeordnet ist, wobei die Informationsspur in der Information enthaltene Pilotsignale führt, deren Phasenwinkel in benachbarten Gängen zu sich ausgerichtet ist.

2. Medium nach Anspruch 1, bei dem die Pilotsignale bei einer konstanten Frequenz liegen, die wesentlich niedriger ist als ein wesentlicher Teil der Frequenzkomponenten der Information.

3. Medium nach Anspruch 1 oder 2 in Form einer Scheibe, wobei der Pilotsignalteil der aufgezeichneten Information eine ganze Zahl von Zyklen pro Gang der Spur beinhaltet.

4. Medium nach einem der Ansprüche 1 bis 3, wobei der Informationssignalteil der aufgezeichneten Information ein modulierter Träger ist, das Aufzeichnungsmedium eine Licht-

reflektierende Scheibe ist und jeder Gang der Informationsspur darin eine Folge von mit Abstand vorgesehenen nicht-reflektierenden Bereichen aufweist, und das Tastverhältnis des aufgezeichneten Musters der nicht-reflektierenden Bereiche in Entsprechung zur Phase des Pilotsignals variiert.

5. Verfahren zum Lesen von Information aus einer Informationsspur, die in einer Anzahl von spiralförmigen oder konzentrischen kreisförmigen Gängen auf einem Speichermedium angeordnet ist, wobei die Spur auch Pilotsignale führt, die in der Phase radial in den Gängen ausgerichtet sind, bei welchem Verfahren die Pilotsignale aus der ausgelesenen Information abgetrennt und zur Regelung des Auslesebetriebes verwendet werden.

6. Verfahren nach Anspruch 5, bei dem die Information und Pilotsignale in Form einer Frequenzmodulation einer Trägerfrequenz vorliegen, bei dem der Träger demoduliert wird, und die Motorgeschwindigkeit nicht geregelt wird, wenn sich die tatsächliche Motorgeschwindigkeit von der gewünschten Motorgeschwindigkeit um mehr als eine nicht vorherbestimmte Größe unterscheidet, und/oder wenn der Träger nicht richtig moduliert ist, und/oder wenn die Pilotsignale nicht von der Information getrennt werden.

7. Verfahren nach Anspruch 5 oder 6, bei dem ein Bezugssignal mit einer Frequenz, die für die gewünschte Geschwindigkeit der Bewegung des Mediums relativ zu den Rückgewinnungsmitteln repräsentativ ist, erzeugt wird, und dessen Phase mit der Phase der abgetrennten Pilotsignale verglichen wird, und ein Steuersignal zur Regelung der Geschwindigkeit des Speichermediums erzeugt.

8. Verfahren nach einem der Ansprüche 5 bis 7, bei dem die Geschwindigkeit des Mediums nur geregelt wird, wenn Pilotsignale rückgewonnen werden, und nicht, wenn andere Information rückgewonnen wird.

9. Verfahren nach einem der Ansprüche 5 bis 8, welches wirksam ist, wenn ein Leser für die Information und Pilotsignale nicht mittig auf die Spur ausgerichtet ist, oder wenn er sich von einem Gang der Spur zu einem anderen bewegt.

10. Verfahren nach einem der Ansprüche 5 bis 9, bei dem ein erstes Motorsteuersignal von einem Vergleich der Phase des Bezugssignals mit dem Pilotsignal abgeleitet wird, die von einem Motor zum Antrieben des Mediums entwickelte Gegen-EMK gemessen und mit einem vorherbestimmten Pegel verglichen wird, um ein zweites Motorsteuersignal zu erzeugen, und ein Regelsignal erzeugt wird, wenn der Unterschied zwischen der Geschwindigkeit des Mediums und der gewünschten Geschwindigkeit einen vorherbestimmten Schwellenwert überschreitet, und in Abhängigkeit von diesem Regelsignal das erste Motorsteuersignal am Regulieren der Geschwindigkeit des Mediums gehindert wird.

11. Verfahren nach einem der Ansprüche 5 bis 10, bei dem Information vom Medium mittels eines Strahlenbündels rückgewonnen wird, welches auf das Medium mit einer Linse fokussiert wird, die Mittel zum Detektieren, wenn das Bündel auf die Spur fokussiert ist, aufweist, und bei dem in einem Fokussierungsschritt die Linse zuerst in eine Anfangsposition zurückgezogen wird, die durch die Stelle definiert ist, an der das Pilotsignal nich detektiert wird, und sodann relativ zum Medium bewegt wird, bis detektiert wird, daß Fokussierung erreicht wurde.

12. Informationsrückgewinnungsvorrichtung mit einem Motor, um eine Relativdrehung zwischen einem Informationsspeichermedium nach einem der Ansprüche 1 bis 4 und einem Leser für die auf dem Medium gespeicherte Information und gespeicherten Pilotsignale vorzusehen, mit Mitteln zum Abtrennen von Pilotsignalen von der vom Leser ausgelesenen Information, und mit einer auf die Pilotsignale ansprechenden Regelung, um den Motor und/oder den Leser zu regeln.

13. Vorrichtung nach Anspruch 12, mit Mitteln zum Erzeugen eines Bezugssignals, das für die gewünschte Geschwindigkeit des Mediums repräsentativ ist, mit einem Filter zum Abtrennen der Pilotsignale von der Information in der Spur, und mit einem Komparator, der die Phase des Bezugssignals mit jener der Pilotsignale vergleicht, um ein erstes Motorsteuersignal zur Regelung eines das Medium antriebenden Motors zu erzeugen.

14. Vorrichtung nach Anspruch 13, bei der das Filter ein Breitbandpaß- und ein Schmalbandpaßfilter beinhaltet, wobei die Bandbreite des Schmalbandpaßfilters kleiner ist also die Bandbreite des Breitbandpaßfilters, bei der eine phasenverriegelte Schleife vorgesehen ist, um die Ausgangssignale des Breitbandpaßfilters und des Schmalbandpaßfilters zu empfangen und ein gefiltertes Pilotsignal zu erzeugen, und ein Amplitudendetektor vorgesehen ist, um den Ausgang des Breitbandpaßfilters immer dann aus der phasenverriegelten Schleife auszukoppeln, wenn festgestellt wird, daß das rückgewonnene Pilotsignal am Ausgang des Schmalbandpaßfilters vorliegt.

15. Vorrichtung nach einem der Ansprüche 12 bis 13, mit Mitteln zum Messen der Gegen-EMK, die vom Motor zum Antreiben des Mediums erzeugt wird, mit Mitteln zum Vergleichen der gemessenen Gegen-EMK mit einem vorherbestimmten Pegel, um ein zweites Steuersignal zum Regulieren der Motorgeschwindigkeit zu erzeugen, und mit Mitteln, die darauf ansprechen, wenn der Unterschied zwischen der tatsächlichen und der gewünschten Motorgeschwindigkeit einen vorherbestimmten Schwellenwert überschreitet, um das erste Motorsteuersignal daran zu hindern, die Motorgeschwindigkeit zu regulieren.

16. Vorrichtung nach einem der Ansprüche 12 bis 15, mit auf das rückgewonnene Pilotsignal und das Bezugssignal ansprechenden Verzögerungsmitteln zum Verzögern der rück-

gewonnenen Information um einen Wert, der in Übereinstimmung mit einer beliebigen Differenz in der Phase der beiden Signale variiert.

17. Vorrichtung nach einem der Ansprüche 12 bis 16, mit einem Demodulator für die Frequenzmodulation einer Trägerfrequenz, die Information auf dem Speichermedium vorsieht, und mit Mitteln zum Verhindern einer Regelung der Motorgeschwindigkeit in Abhängigkeit von einem Detektor, wenn die Trägerfrequenz nicht demoduliert wird, und/oder in Abhängigkeit von Mitteln zum Feststellen, wenn die tatsächliche Motorgeschwindigkeit von der gewünschten Geschwindigkeit um mehr also einen vorherbestimmten Wert abweicht, und/oder in Abhängigkeit von Mitteln, die feststellen, daß die Pilotsignale nicht von der Information getrennt werden.

18. Vorrichtung nach einem der Ansprüche 12 bis 17, mit einer Linse zum Richten eines Strahlenbündels einer Auslesestrahlung auf das Speichermedium und mit Mitteln zum Feststellen, wenn das Strahlenbündel auf einen Gang der Spur fokussiert ist, mit Mitteln zum anfänglichen Zurückziehen der Linse in eine Anfangsposition, und mit Mitteln, die, nachdem die Linse in die Anfangsposition zurückgezogen worden ist, betätigbar sind, um die Linse relativ zum Speichermedium zu bewegen, bis Fokussierungsdetektionsmittel feststellen, daß Fokussierung auf den ausgewählten Gang der Spur erreicht wurde, wobei die Anfangsposition der Linse durch die Stelle definiert ist, an der das Pilotsignal nicht mehr durch die Abtastmittel detektiert wird.

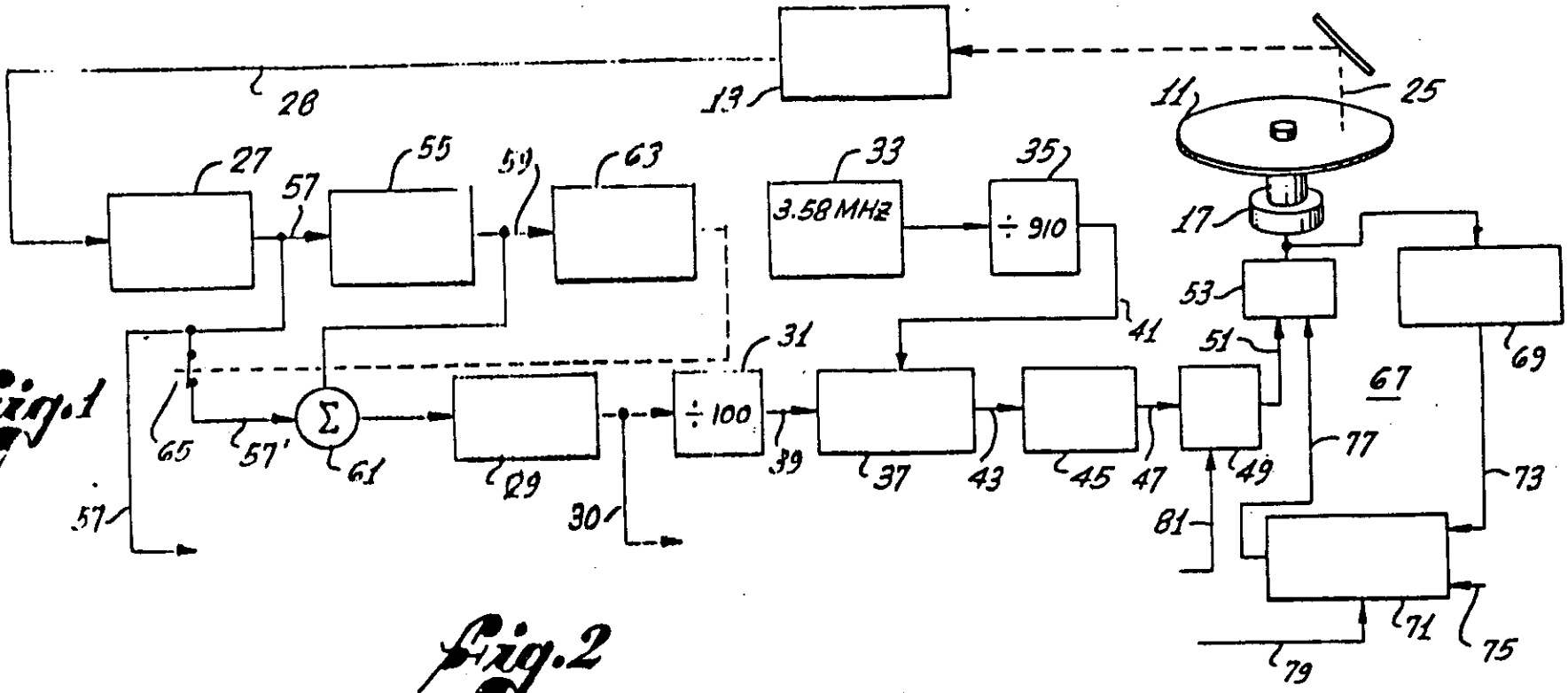

Fig. 1

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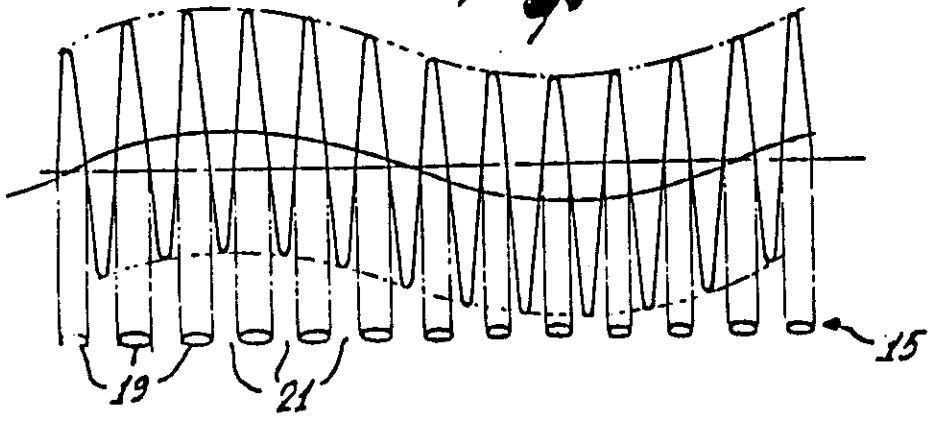
Fig. 2



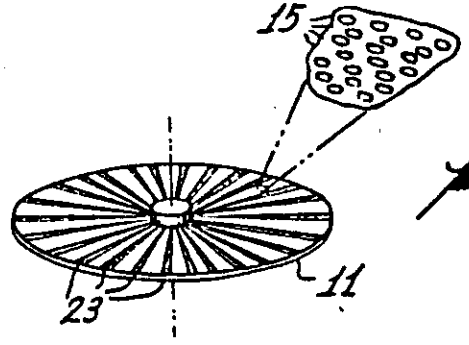


Fig. 3

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(54)
Verfahren und Vorrichtung zum Überwachen des Lesens von Informationen von einem Speichermedium
Method and apparatus for controlling the reading of information from an information storage medium
Procédé et dispositif pour contrôler la lecture d'informations d'un porteur d'enregistrement

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