

Description

The present invention relates to apparatus for controlling rotation of a drum motor of, for example, a video tape recorder.

In a video tape recorder (VTR) in which a rotary head is mounted on a rotary head drum, a servo circuit is generally used to stabilize the revolution rate of a rotary head (see Japanese Laid-Open Patent Gazette No. 61-39877 and so on).

Figure 1 of the accompanying drawings illustrates an example of a conventional servo circuit that controls a rotary head drum. Such a circuit is comparable to that disclosed in EP-A-0249465.

Referring to Figure 1, there is shown a rotary head drum 1 which is rotated by a motor 2. A frequency generator 3 and a pulse generator 4 are mounted on the peripheral surface of the rotary head drum 1. The frequency generator 3 is adapted to generate a frequency signal FG of, for example, 720 Hz at normal running speed or to generate a signal each time the rotary head drum 1 is rotated by a predetermined angle (for example, 15°). The pulse generator 4 is adapted to generate a pulse signal of, for example, 30Hz or to generate a pulse signal at every revolution of the rotary head drum 1.

The signal FG from the frequency generator 3 and the signal PG from the pulse generator 4 are both supplied to a servo signal processor section 5 represented in phantom in Figure 1. This servo signal processor section 5 might be formed of an integrated circuit (IC). The signal FG supplied to the servo signal processor section 5 is supplied to a cycle detector circuit 6 therein. The cycle detector circuit 6 detects the rotational speed of the rotary head drum 1 on the basis of the signal FG and produces a voltage signal corresponding to the detected signal and thereby indicative of the rotational speed of the rotary head drum 1. The signal PG supplied to the servo signal processor section 5 is supplied to a first comparing signal input terminal of a phase difference detector circuit 7 therein. A reference signal generator 8 in the servo signal processor circuit 5 is adapted to generate a reference signal V_D synchronized with the vertical synchronizing signal. When the video tape recorder is operated in the playback mode, a mode changing signal is supplied through a terminal 8a to the reference signal generator circuit 8 to disconnect the terminal 9 therefrom and the reference signal generator 8 itself generates the reference signal V_D . Then, the phase difference detector circuit 7 detects a phase difference between the pulse signal PG and the reference signal V_D and produces a voltage signal corresponding to the detected phase difference therebetween.

The voltage signal from the cycle detector circuit 6 is supplied to a plus (+) input terminal of a subtractor circuit 10. Also, a voltage signal corresponding to reference speed data obtained at a terminal 11 is supplied to a minus (-) input terminal of the subtractor circuit 10. Thus, the subtractor circuit 10 subtracts the voltage signals through the terminal 11 from the voltage signal of the detector circuit 6 to produce a subtracted voltage signal that indicates the difference between the reference speed and the actual speed. The subtracted signal is supplied to a first adding signal input terminal of an adder circuit 12 and the voltage signal from the phase difference detector circuit 7 is supplied to a second adding signal input terminal of the adder circuit 12. Thus, the adder circuit 12 adds the subtracted signal and the voltage signal each other to produce an added signal of the speed difference and the phase difference. Then, the added signal from the adder circuit 12 is supplied to a phase compensator circuit 13 and is thereby phase-compensated. The output signal from the phase compensator circuit 13 is supplied to a driver circuit 14, and this driver circuit 14 drives the drum motor 2 to rotate the rotary head drum 1.

When the drum motor 2 is servo-controlled in the way, in the recording mode of the video tape recorder, the rotary head drum 1 is controlled to rotate in synchronism with the video signal to be recorded, while upon reproduction the rotary head drum 1 is controlled to rotate in synchronism with the reference signal produced within the video tape recorder.

However, if a pulse signal PG of about 30 Hz from the pulse generator 4 is used to detect the phase difference, there is the disadvantage that the rotary head drum 1 cannot be rotated stably without taking a relatively long time to stabilize.

Further, when in the playback mode the video tape recorder performs the variable tape speed reproduction such as a high-speed reproduction and so on, the revolution speed of the rotary head drum 1 has to be varied. In this case, the frequency of the reference signal V_D from the reference signal generator circuit 8 has to be varied, making the reference signal generator circuit 8 complicated in arrangement.

EP-A-0055146 discloses a digital servo system for controlling the speed of a general electric motor and is not concerned with stabilization of the speed and phase of rotation of a drum motor.

EP-A-0239665 discloses an electronic digitized proportional-integral controller for synchronizing the speeds of two motors in a photocopier.

According to the present invention, there is provided apparatus for controlling rotation of a motor, said apparatus comprising:

a driver circuit and a servo circuit;

said servo circuit comprising:
 means for generating a frequency signal (FG)
 corresponding to a revolution speed of the motor;
 means responsive to said frequency signal
 generating means for detecting a cycle of the fre-
 quency signal from said frequency signal generat-
 ing means to produce a detected signal; and
 means for generating a reference speed signal;
 characterized in that:
 the apparatus is adapted to control rotation of a
 rotary head drum motor;

the servo circuit further comprises:
 means responsive to said detecting means and
 said reference speed signal generating means for
 detecting a speed deviation between the detected
 signal from said detecting means and the reference
 speed signal to produce a speed deviation signal;
 means responsive to said speed deviation sig-
 nal producing means for generating a speed con-
 trol signal based on the speed deviation signal;
 means responsive to said speed deviation sig-
 nal producing means for effecting an integration of
 the speed deviation signal;

means responsive to said integration means for
 producing a phase control signal based on the
 integration of the speed deviation signal; and

means responsive to said speed control signal
 generating means and said phase control signal
 producing means for adding the speed control sig-
 nal and the phase control signal to produce a
 rotation control signal; and

the drive circuit is arranged to receive the
 rotation control signal and to drive the drum motor
 in response to the rotation control signal.

Said apparatus is capable of controlling the
 drum motor to rotate stably and is capable of
 stabilizing the rotation in a short time period.

A better understanding of the present invention
 can be gained from a consideration of the following
 detailed description of the preferred embodiment
 thereof, in conjunction with the figures of the ac-
 companying drawings, wherein

Figure 1 is a diagram showing an example of a
 conventional motor control apparatus; and

Figure 2 is a diagram showing an embodiment
 of motor control apparatus according to the
 present invention.

Now, an embodiment of motor control appara-
 tus according to the present invention will
 hereinafter be described with reference to Figure 2.
 In Figure 2, like parts corresponding to those of
 figure 1 are marked with the same references and
 therefore need not be described in detail.

Similarly to figure 1, a servo circuit in this
 embodiment is adapted to control the rotation of
 the rotary head drum 1 on which is mounted a
 rotary head in a video tape recorder, so this servo
 circuit is used in the reproduction mode of the

video tape recorder.

As figure 2 shows, there is provided the rotary
 head drum 1, and the frequency generator 3 is
 mounted on the peripheral surface of this rotary
 head drum 1 to generate the frequency signal FG.
 This frequency signal FG is supplied to a servo
 processor section 20 represented in phantom in
 figure 2. The servo signal processor section 20
 might be of an integrated circuit configuration. In
 this embodiment, the frequency generator 3 is
 adapted to generate the frequency signal FG which
 has one period or cycle for every 15° rotation of
 the rotary head drum 1. Accordingly, if the rotary
 head drum 1 is rotated 30 times per second in its
 stable state, the frequency of the FG signal pro-
 duced by generator 3 is 720 Hz.

The signal FG supplied to the servo signal
 processor section 20 is supplied to a cycle detec-
 tor circuit 21 therein. The cycle detector circuit 21
 detects the revolution speed of the rotary head
 drum 1 on the basis of the frequency signal FG.
 The detected signal therefrom is supplied to a plus
 (+) input terminal of a subtractor circuit 22. A
 reference speed signal corresponding to a tape
 speed of the video tape recorder is applied through
 a terminal 23 to a minus (-) input terminal of the
 subtractor circuit 22. Thus, the subtractor circuit 22
 subtracts the reference speed signal from the de-
 tected signal to produce a subtracted signal as a
 speed deviation signal that indicates the difference
 between the reference speed and the actual rota-
 tional speed of the rotary head drum 1.

In this embodiment, the subtracted signal is
 supplied as the speed deviation signal to a first
 constant circuit 24. This first constant circuit 24
 multiplies the speed deviation signal by K_0 (which
 is a constant) to provide a speed control signal
 which is supplied to a first adding signal input
 terminal of an adder circuit 27. Further, the sub-
 tracted signal as the speed deviation signal is
 supplied to an integrator circuit 25. The integrator
 circuit 25 integrates the speed deviation signal and
 converts the same into a phase information signal.
 In other words, the integrator circuit 25 performs
 the integration expressed by the function

$$\left(\frac{1}{1 - z^{-1}} \right).$$

The phase information signal obtained by the in-
 tegration is supplied to a second constant circuit
 26. The second constant circuit 26 multiplies the
 phase information signal by K_1 to produce a phase
 control signal where K_1 is a constant. The phase
 control signal from the second constant circuit 26

is supplied to a second adding signal input terminal of the adder circuit 27. The adder circuit 27 adds the speed control signal and the phase control signal to produce a rotation control signal. This rotation control signal from the adder circuit 27 is supplied to the driver circuit 14, and the driver circuit 14 drives the drum motor 2 to rotate the rotary head drum 1.

When the rotary head drum 1 is rotated as described above, the speed control signal and the phase control signal are obtained on the basis of the frequency signal FG having a relatively high frequency, for example, 720 Hz. Thus, the speed control signal and the phase control signal are both generated during a short interval corresponding to the frequency of 720 Hz so that the rotation of the drum motor 2 can be stabilized in a short period of time, resulting in high stability of rotation.

In a variable tape speed playback mode such as a high-speed search mode and so on, it is sufficient that the reference speed signal supplied to the terminal 23 is varied to a signal corresponding to the playback speed. By way of example, if the reference speed signal is a voltage signal, it is sufficient that the voltage value of this voltage signal is changed without need to change an oscillation frequency or the like unlike the prior art. Thus, the servo signal processor section 20 can be simplified in arrangement.

According to the apparatus of the present invention, the rotation of the drum motor can be stabilized in a short period of time. Further, the rotational speed can be varied by the simple arrangement and the rotation of the drum motor can be controlled with high stability and with ease.

Claims

1. Apparatus for controlling rotation of a motor (2), said apparatus comprising:
 - a driver circuit (14) and a servo circuit;
 - said servo circuit comprising:
 - means (3) for generating a frequency signal (FG) corresponding to a revolution speed of the motor (2);
 - means (21) responsive to said frequency signal generating means for detecting a cycle of the frequency signal from said frequency signal generating means to produce a detected signal; and
 - means for generating a reference speed signal;
 - characterized in that:
 - the apparatus is adapted to control rotation of a rotary head drum motor (2);
 - the servo circuit further comprises:
 - means (22) responsive to said detecting means (21) and said reference speed signal

generating means (23) for detecting a speed deviation between the detected signal from said detecting means and the reference speed signal to produce a speed deviation signal;

means (24) responsive to said speed deviation signal producing means (22) for generating a speed control signal based on the speed deviation signal;

means (25) responsive to said speed deviation signal producing means (22) for effecting an integration of the speed deviation signal;

means (26) responsive to said integration means (25) for producing a phase control signal based on the integration of the speed deviation signal; and

means (27) responsive to said speed control signal generating means (24) and said phase control signal producing means (26) for adding the speed control signal and the phase control signal to produce a rotation control signal; and

the drive circuit (14) is arranged to receive the rotation control signal and to drive the drum motor (2) in response to the rotation control signal.

2. Apparatus as claimed in claim 1, wherein said speed control signal generating means (24) is a first constant circuit.
3. Apparatus as claimed in claim 2, wherein said first constant circuit is arranged to multiply the speed deviation signal by a first constant (K_0).
4. Apparatus as claimed in any of the preceding claims, wherein said phase control signal producing means includes a second constant circuit (26).
5. Apparatus as claimed in claim 4, wherein said integration means (25) is arranged to produce a phase information signal for supply to the phase control signal producing means (26).
6. Apparatus as claimed in claim 5, wherein said second constant circuit (26) is arranged to multiply the phase information signal by a second constant (K_1).
7. Apparatus as claimed in any of the preceding claims, wherein said reference signal corresponds to a running speed of a tape wound around the rotary head drum.
8. A tape recording and/or reproducing apparatus having a rotatable drum containing a transducer head, a head drum motor (2) for rotating



is supplied to a second adding signal input terminal of the adder circuit 27. The adder circuit 27 adds the speed control signal and the phase control signal to produce a rotation control signal. This rotation control signal from the adder circuit 27 is supplied to the driver circuit 14, and the driver circuit 14 drives the drum motor 2 to rotate the rotary head drum 1.

When the rotary head drum 1 is rotated as described above, the speed control signal and the phase control signal are obtained on the basis of the frequency signal FG having a relatively high frequency, for example, 720 Hz. Thus, the speed control signal and the phase control signal are both generated during a short interval corresponding to the frequency of 720 Hz so that the rotation of the drum motor 2 can be stabilized in a short period of time, resulting in high stability of rotation.

In a variable tape speed playback mode such as a high-speed search mode and so on, it is sufficient that the reference speed signal supplied to the terminal 23 is varied to a signal corresponding to the playback speed. By way of example, if the reference speed signal is a voltage signal, it is sufficient that the voltage value of this voltage signal is changed without need to change an oscillation frequency or the like unlike the prior art. Thus, the servo signal processor section 20 can be simplified in arrangement.

According to the apparatus of the present invention, the rotation of the drum motor can be stabilized in a short period of time. Further, the rotational speed can be varied by the simple arrangement and the rotation of the drum motor can be controlled with high stability and with ease.

Claims

1. Apparatus for controlling rotation of a motor (2), said apparatus comprising:
 - a driver circuit (14) and a servo circuit;
 - said servo circuit comprising:
 - means (3) for generating a frequency signal (FG) corresponding to a revolution speed of the motor (2);
 - means (21) responsive to said frequency signal generating means for detecting a cycle of the frequency signal from said frequency signal generating means to produce a detected signal; and
 - means for generating a reference speed signal;
 - characterized in that:
 - the apparatus is adapted to control rotation of a rotary head drum motor (2);
 - the servo circuit further comprises:
 - means (22) responsive to said detecting means (21) and said reference speed signal

generating means (23) for detecting a speed deviation between the detected signal from said detecting means and the reference speed signal to produce a speed deviation signal;

means (24) responsive to said speed deviation signal producing means (22) for generating a speed control signal based on the speed deviation signal;

means (25) responsive to said speed deviation signal producing means (22) for effecting an integration of the speed deviation signal;

means (26) responsive to said integration means (25) for producing a phase control signal based on the integration of the speed deviation signal; and

means (27) responsive to said speed control signal generating means (24) and said phase control signal producing means (26) for adding the speed control signal and the phase control signal to produce a rotation control signal; and

the drive circuit (14) is arranged to receive the rotation control signal and to drive the drum motor (2) in response to the rotation control signal.

2. Apparatus as claimed in claim 1, wherein said speed control signal generating means (24) is a first constant circuit.
3. Apparatus as claimed in claim 2, wherein said first constant circuit is arranged to multiply the speed deviation signal by a first constant (K_0).
4. Apparatus as claimed in any of the preceding claims, wherein said phase control signal producing means includes a second constant circuit (26).
5. Apparatus as claimed in claim 4, wherein said integration means (25) is arranged to produce a phase information signal for supply to the phase control signal producing means (26).
6. Apparatus as claimed in claim 5, wherein said second constant circuit (26) is arranged to multiply the phase information signal by a second constant (K_1).
7. Apparatus as claimed in any of the preceding claims, wherein said reference signal corresponds to a running speed of a tape wound around the rotary head drum.
8. A tape recording and/or reproducing apparatus having a rotatable drum containing a transducer head, a head drum motor (2) for rotating



the head drum and a control apparatus as claimed in any of the preceding claims for controlling rotation of the head drum motor.

Patentansprüche

1. Vorrichtung zur Regelung der Drehbewegung eines Motors (2) mit
 - einer Treiberschaltung (14) und einer Servoschaltung,
 wobei die Servoschaltung aufweist:
 - eine Frequenzsignal-Generatoreinrichtung (3) zur Erzeugung eines Frequenzsignals (FG), das der Rotationsgeschwindigkeit des Motors (2) entspricht,
 - eine auf die Frequenzsignal-Generatoreinrichtung ansprechende Detektoreinrichtung (21) zur Detektierung des Zyklus des von der Frequenzsignal-Generatoreinrichtung kommenden Frequenzsignals und zur Erzeugung eines entsprechenden Detektorsignals, und
 - eine Einrichtung zur Erzeugung eines Referenzgeschwindigkeitssignals, **dadurch gekennzeichnet,** daß die Vorrichtung zur Regelung des Trommelmotors (2) für eine rotierende Kopftrommel geeignet ist,
 - daß die Servoschaltung weiterhin aufweist:
 - eine auf die Detektoreinrichtung (21) und die Einrichtung (23) zur Erzeugung des Referenzgeschwindigkeitssignals ansprechende Einrichtung (22) zur Detektierung einer Geschwindigkeitsabweichung zwischen dem aus der Detektoreinrichtung kommenden Detektorsignal und dem Referenzgeschwindigkeitssignal und zur Erzeugung eines entsprechenden Geschwindigkeitsabweichungssignals,
 - eine auf die Einrichtung (22) zur Erzeugung des Geschwindigkeitsabweichungssignals ansprechende Einrichtung (24) zur Erzeugung eines Geschwindigkeitsregelungssignals auf der Basis des Geschwindigkeitsabweichungssignals,
 - eine auf die Einrichtung (22) zur Erzeugung des Geschwindigkeitsregelungssignals ansprechende Integratoreinrichtung (25) zur Integration des Geschwindigkeitsabweichungssignals,
 - eine auf die Integratoreinrichtung (25) ansprechende Einrichtung (26) zur Erzeugung eines Phasenregelungssignals auf der Basis des Geschwindigkeitsabweichungssignals, und
 - eine auf die Einrichtung (24) zur Erzeugung des Geschwindigkeitsregelungssignals und die Einrichtung (26) zur Erzeugung des Phasenregelungssignals an-

sprechende Addiereinrichtung (27) zum Addieren des Geschwindigkeitsregelungssignals und des Phasenregelungssignals und zur Erzeugung eines Rotationsregelungssignals,

und daß die Treiberschaltung (14) so angeordnet ist, daß sie das Rotationsregelungssignal aufnimmt und den Trommelmotor in Abhängigkeit von dem Rotationsregelungssignal steuert.

2. Vorrichtung nach Anspruch 1, bei der die Einrichtung (24) zur Erzeugung des Geschwindigkeitsregelungssignals eine erste Konstantenschaltung ist.
3. Vorrichtung nach Anspruch 2, bei der die erste Konstantenschaltung so angeordnet ist, daß sie das Geschwindigkeitsabweichungssignal mit einer ersten Konstanten (K_0) multipliziert.
4. Vorrichtung nach einem der vorhergehenden Ansprüche, bei der die Einrichtung zur Erzeugung des Phasenregelungssignals eine zweite Konstantenschaltung (26) aufweist.
5. Vorrichtung nach Anspruch 4, bei der die Integratoreinrichtung (25) so angeordnet ist, daß sie ein der Einrichtung (26) zur Erzeugung des Phasenregelungssignals zuzuführendes Phaseninformationssignal erzeugt.
6. Vorrichtung nach Anspruch 5, bei der die zweite Konstantenschaltung (26) so angeordnet ist, daß sie das Phaseninformationssignal mit einer zweiten Konstanten (K_1) multipliziert.
7. Vorrichtung nach einem der vorhergehenden Ansprüche, bei der das genannte Referenzsignal der Laufgeschwindigkeit eines um die Kopftrommel geschlungenen Bandes entspricht.
8. Band-Aufnahme- und/oder -Wiedergabegerät, das eine rotierende Kopftrommel mit einem Wandlerkopf, einen Kopftrommelmotor (2) zum Drehen der Kopftrommel und eine Regelungsvorrichtung nach einem der vorhergehenden Ansprüche zur Regelung der Rotation des Kopftrommelmotors aufweist.

Revendications

1. Dispositif d'asservissement de la rotation d'un moteur (2), ledit dispositif comportant:
 - un circuit d'entraînement (14) et un servo-circuit;
 - ledit servo-circuit comportant:



- des moyens (3) pour générer un signal de fréquence (FG) correspondant à une vitesse de rotation du moteur (2);
- des moyens (21), sensibles auxdits moyens de génération d'un signal de fréquence, pour détecter un cycle du signal de fréquence provenant desdits moyens de génération d'un signal de fréquence pour produire un signal détecté; et
- des moyens pour générer un signal de vitesse de référence;
- dispositif caractérisé
- par le fait que le dispositif est conçu pour asservir la rotation d'un moteur (2) de tambour de tête rotative;
- par le fait que le servo-circuit comporte en outre:
- des moyens (22), sensibles auxdits moyens de détection (21) et auxdits moyens (23) de génération d'un signal de vitesse de référence, pour détecter un écart de vitesse entre le signal détecté provenant desdits moyens de détection et le signal de vitesse de référence pour produire un signal d'écart de vitesse;
- des moyens (24) sensibles auxdits moyens (22) de production d'un signal d'écart de vitesse pour générer un signal d'asservissement de la vitesse sur la base du signal d'écart de vitesse;
- des moyens (25), sensibles auxdits moyens (22) de production d'un signal d'écart de vitesse, pour effectuer une intégration du signal d'écart de vitesse;
- des moyens (26) sensibles auxdits moyens d'intégration (25), pour produire un signal d'asservissement de phase sur la base de l'intégration du signal d'écart de vitesse; et
- des moyens (27) sensibles auxdits moyens (24) de génération du signal d'asservissement de la vitesse et auxdits moyens (26) de production du signal d'asservissement de la phase pour additionner le signal d'asservissement de la vitesse et le signal d'asservissement de la phase pour produire un signal d'asservissement de la rotation; et
- par le fait que le circuit d'entraînement (14) est conçu pour recevoir le signal d'asservissement de la rotation et pour entraîner le moteur du tambour (2) en réponse au signal d'asservissement de la rotation.
2. Dispositif selon la revendication 1, dans lequel lesdits moyens (24) de génération du signal d'asservissement de la vitesse sont un circuit comportant une première constante.

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3. Dispositif selon la revendication 2, dans lequel ledit circuit comportant une première constante est conçu pour multiplier le signal d'écart de vitesse par une première constante (K_0).
4. Dispositif selon l'une quelconque des revendications précédentes, dans lequel ledit moyen de production du signal d'asservissement de phase incluent un circuit (26) comportant une seconde constante.
5. Dispositif selon la revendication 4, dans lequel lesdits moyens d'intégration (25) sont conçus pour produire un signal d'information de phase pour l'envoyer aux moyens (26) produisant le signal d'asservissement de phase.
6. Dispositif selon la revendication 5, dans lequel ledit circuit (26) comportant une seconde constante est conçu pour multiplier le signal d'information de phase par une seconde constante (K_1).
7. Dispositif selon l'une quelconque des revendications précédentes, dans lequel ledit signal de référence correspond à une vitesse de marche d'une bande bobinée autour du tambour de la tête rotative.
8. Dispositif d'enregistrement sur bande et/ou leur produit de reproduction comportant un tambour rotatif contenant une tête de transducteur, un moteur (2) de tambour de tête pour entraîner en rotation le tambour de tête et un dispositif d'asservissement comme revendiqué dans l'une quelconque des revendications précédentes pour asservir la rotation du moteur du tambour de tête.