

Description

Field of the Invention

This invention relates to a rotational velocity control with pulse width modulation. This invention is well suited for use with the spindle servo error generator of a videodisc mastering machine.

Description of the Prior Art

Spindle servo error generators are known in the videodisc art, for use with both videodisc mastering machines and videodisc players. In either case, it is the function of the spindle servo to rotate the disc at a prescribed rate as compared with a reference signal, and when it is determined that the spindle motor is not precisely in step with the reference signal, an error signal is generated to alter the speed of the spindle motor to return it to the desirable speed. Precision control of the servo system in such devices is essential, since the speed of the spindle motor has a direct correspondence to the time base of the video program being recorded or played back.

Accurate time base of the recorded or reproduced program must be maintained in both commonly used videodisc program formatting systems, i.e., the CAV or constant angular velocity format and the CLV or constant linear velocity format. A typical system for rotating a disc at a constant angular velocity thereby maintaining proper time base is known in prior art. Similarly, a typical spindle servo system of the RC network relative to the rotational time period of the disc is substantially decreased, and optimum operation is clearly not possible for all rotational speeds of the disc.

Principle of Operation of the Invention

An improvement to existing time base corrector schemes, i.e., spindle servo control schemes, operates on a pulse width modulation technique for controlling the spindle motor speed. In such an arrangement, rather than to phase compare two AC signals, one from the reference oscillator and one from the tachometer, a three-stage shift register is provided whose output is pulse width modulated by the difference in time relationship between two pulse train inputs, one pulse train representing a reference standard and the other representing the tachometer output. In a preferred embodiment, the standard reference pulses are applied to the first stage of the shift register to shift a zero toward the other end of the register. Simultaneously, the tachometer pulses are applied to the third stage of the shift register and serve to shift a one toward the first stage.

It should be mentioned here that US-A-3 971 994 discloses a circuit arrangement which is in a broad sense, related to the same field of art as the arrangement described above. More particularly, that patent discloses a circuit arrangement which employs a multi-stage shift register containing a binary digit in one of the central stages, with pulses from two different

pulse trains being alternately applied to the register, wherein the individual pulses of each train alternately cause the binary digit to be moved through one stage, but in opposite senses. The purpose of that arrangement is to periodically determine the position of the binary digit in order to monitor the difference between the repetition frequencies of the two pulse trains.

If, for example, the reference pulses and tachometer pulses are separated by precisely half the pulse recurrence time (PRT), a 50% duty cycle square wave is produced at the output of the second stage. That is, starting at one point in time, a tach pulse shifts a logical 1 from the third stage to the second stage causing the second stage output to go high. The next reference pulse shifts a 0 from the first stage to the second stage causing the output of the second stage to return to a 0 condition, the output of the second stage therefore remains high for 1/2 PRT. If the reference pulses and tach pulses are precisely aligned so that the two pulse trains are offset symmetrically, a 50% duty cycle square wave signal will appear at the output of the second stage of the shift register. Thus, when the pulse trains are not symmetrically aligned, as when the spindle motor is not following the reference pulses, the pulse width out of the second stage of the shift register has a duty cycle greater or less than 50%, and this change can be detected by known filtering, compensation, and amplifying means to control the servo mechanism and return the speed of the spindle motor to a value such that the reference and tach pulse trains are again properly aligned. Of course, any predetermined duty cycle could be used as a reference from which spindle motor speed errors are derived, and the 50% duty cycle example just given is merely indicative of the technique used.

More particularly, for comparing the outputs of the first and third stages of the shift register of a spindle servo control system, and upon detection that the logical states of the first and third stages of the three-stage shift register are the same, generating an output error signal. Appropriate gating logic elements are provided to accomplish this objective, and, in a preferred embodiment, a one shot multivibrator is enabled by the leading edge of the error signal so as to create a pulse of longer duration when required by the using device.

According to a first aspect the invention comprises a method of controlling the rotational velocity of a rotating member to rotate said member at a desired velocity, comprising the steps of: providing a drive means for rotating said rotating member; generating a first pulse train representing the instantaneous rotational velocity of said rotating member; generating a reference pulse train having an instantaneous frequency equal to that of said first pulse train when said rotating member is rotating at said desired velocity; providing a three-stage shift register capable of shifting bidirectionally; loading a 0 into the first stage of the shift register; loading a 1 into

the third stage of the shift register; shifting the 0 loaded into said first stage toward said third stage with said first pulse train; shifting the 1 loaded into said third stage toward said first stage with said second pulse train, said shifting steps producing, at the output of the second stage of the shift register, a pulse width modulated third pulse train modulated in accordance with the change in time position of the pulses of said first pulse train relative to the pulses of said reference pulse train; and detecting the pulse width modulated output of the second stage of the shift register, and utilizing the detected output to vary the drive to said drive means to effect a change in rotational velocity of said rotating member corresponding to the modulation of said third pulse train.

According to a second aspect the invention comprises an apparatus for controlling the rotational velocity of a rotating member to rotate said member at a desired velocity, comprising: a drive means for rotating said rotating member; means for generating a first pulse train representing the instantaneous rotational velocity of said rotating member; oscillator means for generating a reference pulse train having an instantaneous frequency equal to that of said first pulse train when said rotating member is rotating at said desired velocity; a three-stage shift register capable of shifting bidirectionally; means for loading a 0 into the first stage of the shift register; means for loading a 1 into the third stage of the shift register; means for shifting the 0 loaded into said first stage toward said third stage with said first pulse train; means for shifting the 1 loaded into said third stage toward said first stage with said second pulse train, said shifting means producing, at the output of the second stage of the shift register, a pulse width modulated third pulse train modulated in accordance with the change in time position of the pulse of said first pulse train relative to the pulses of said reference pulse train; means for detecting the pulse width modulated output of the second stage of the shift register; and means responsive to the detected output of said second stage to vary the drive to said drive means to effect a change in rotational velocity of said rotating member corresponding to the modulation of said third pulse train.

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 spindle servo system of the prior art using phase detecting techniques for controlling the spindle motor speed;

Figure 2 is an improved version of the spindle servo control circuit of Figure 1 in which a three-stage shift register and associated reference and tachometer pulses are used for maintaining accurate spindle motor speed in a pulse width

modulation detection scheme according to the invention;

Figure 3 is a detailed block diagram of the pulse drop-out detector according to the present invention;

Figure 4 is a waveform diagram showing the reference and tachometer pulses and the relationship therebetween to produce the pulse width modulated output for controlling the spindle motor speed;

Figure 5 is a truth table showing the logical states of the stages of the three-stage shift register of Figure 3 as well as the NAND output state in both the proper orientation and improper orientation of the reference and tachometer pulses applied to the shift register.

Description of the Preferred Embodiment

Referring now to the drawings, and particularly to Figure 1, there is shown a servo apparatus for rotating an information storage disc 11 about its central axis 13 at a precisely controlled angular velocity. The disc 11 is rotated relative to an optical transducer 15 which operates to record onto the disc information such as conventional color television signal frequency, modulated on a carrier.

The optical transducer 15 includes means for producing a collimated beam of light (not shown) modulated by the information to be recorded, along with a lens carriage 17 which is controllably movable by a lead screw 19 in a radial direction relative to the disc 11 in order to direct the light beam onto a selected portion of the disc as the disc is rotated with respect to it. This produces a series of substantially circular information tracks forming a spiral on the surface of the disc, each track comprising an alternating sequence of light-reflective regions and light-scattering regions as is well known in the art of laser videodisc technology.

The servo apparatus is shown to include means for producing a velocity signal having a frequency corresponding to the desired angular velocity of the information storage disc 11, together with a spindle motor servo 9, responsive to the velocity signal, for controllably rotating the disc at a corresponding angular velocity. In the constant linear velocity mode, as selected by the CLV/CAV selector 38, the velocity signal has an instantaneous frequency substantially inversally proportional to the radius of the information track being recorded, whereby the track is moved at a substantially constant linear velocity relative to the lens carriage 17, and a uniform information recording density over the entire surface of the disc is achieved. When desirable, a constant frequency oscillator, CAV reference oscillator 37, can be selected by selector 38 to effect the servo control of the spindle motor 51. For detailed operation of the CAV and CLV spindle servo systems, reference is again made to the aforementioned U.S. patent application and U.S. patent.

Basically, in the CAV mode, oscillator 37 out-

puts a constant frequency signal to phase detector 55 which compares the AC output of tachometer 53 representative of the rotational speed of spindle motor 51. Upon detection of a phase difference between the two inputs to detector 55, phase and amplitude compensator 63 creates an output on line 65, amplified by amplifier 67, and applied over line 69 to the spindle motor 51 to correct the spindle motor speed and bring the tachometer output on line 57 in phase with the output of oscillator 37.

Similarly, in the CLV mode, the same analysis applies with the exception that, as lead screw 19 turns to shift the objective lens of lens carriage 17, it also varies the resistance of R45 which when considering the voltage dividing action with resistor 49 and power source V REF is amplified through differential amplifier 47, the arrangement just described and generally indicated at 43 providing a controlling voltage over line 41 proportional to radial distance of the objective lens from the center axis 13 of the disc 11 in order to vary the frequency of voltage controlled oscillator 39. In this manner, as the objective lens increases its radial distance from the disc center, the frequency of voltage controlled oscillator 39 diminishes, and spindle motor 51 servo locks to the constantly changing (lowering) frequency.

In Figure 2, like components are identified with like reference numerals from Figure 1 for ease of operational description. Since the basic spindle servo function and operation are similar, only the differences will now be discussed. At the output of either variable voltage controlled oscillator 39 or constant frequency oscillator 37, a pulse generator 35 and 33, respectively, is provided. The pulse generators 35 and 33 each create a pulse train of constant amplitude and short duration pulses selectable by the CLV/CAV selector 38. Similarly, as opposed to an AC tachometer 53 (of Figure 1), Figure 2 shows a tachometer pulse generator 31 which outputs a series of tach pulses in a pulse train representative of the spindle motor speed. Assuming, for example, that a single pulse is generated by a pulse generator 31 for each revolution of disc 11, the tach pulses, at least in the center of the disc, would be recurring at a rate of 1800 per minute. Of course, in the CLV mode, as the objective lens is driven toward the outer circumferential position of the disc, the tach pulses and reference pulses will be substantially lower in frequency.

In any event, the reference pulse train on line 25 is, preferably, offset by one-half PRT from the tach pulse train on line 23. Shift register 29 has an input 21 to constantly load a 0 into the first stage of the register, while line 22 constantly loads a 1 into the third stage of the register 29. As explained earlier, as the time relationship between the corresponding pulses of the pair of pulse trains changes, the duty cycle of the output on line 24 from the second stage of the shift register 29 will change to carry the information representative of the time shift between the two pulse trains in the form of a pulse width modula-

tion characteristic. Pulse width modulation detector and filter 27 filters the rectangular wave input on line 24 and outputs a changing DC output on line 26 which is amplified in amplifier 67 and applied over line 69 to spindle motor 51 controlling its rotational speed in the manner described above in connection with Figure 1. Since the loss or gain of either a reference pulse or a tachometer pulse would be interpreted by the servo system as a gross spindle motor speed error, it is important to monitor the two pulse trains and become aware of any drop-out of pulses in either of the two pulse trains. A loss of a tachometer pulse, for example, could occur with a dirty contact in the mechanism used to produce the tachometer output pulse. The gain of a pulse, for example, could be due to noise induced into the reference or tachometer signal lines. The circuit of Figure 3 provides a means for indicating the absence or addition of a pulse in either the reference or tachometer pulse trains.

Having reference to Figure 4, it can be seen that when tach pulse 23 is applied to the shift register 29 of figure 3 it serves to shift the 1 loaded into the third stage (C) of shift register 29 to the second stage (B). This is shown in the third line of Figure 4 where the pulse width modulated output signal 24 goes to the logical 1 state at the occurrence of each tach pulse 23. With the next recurring reference pulse 25 applied to the first stage (A) of shift register 29, a logical 0 is shifted from the first stage to the second stage causing the output of the second stage to fall, and this is indicated in Figure 4 on the third line coincident with the occurrence of each reference pulse.

For so long as there are no missing or added reference or tachometer pulses, the pulse width modulated output 24 maintains a substantially square wave form as shown in the third line of Figure 4. When the tachometer pulses begin to vary from the reference pulses, for example when they begin to lead the reference pulses during the recording of a CLV disc, it can be readily observed that the corresponding edge of the output 24 will vary, and this is identified in Figure 4 by arrows 91 and 93. As a result of the shifting of one of the edges of output 24, the pulse width changes correspondingly, and an error signal is created to drive the spindle motor in the proper direction to alter its speed so as to return the pulse width modulated output 24 to its condition prior to change.

Again, for so long as no reference or tachometer pulses are added or omitted, the second stage of shift register 29 will alternately assume logical 1 and 0 states. If a tachometer pulse is omitted, the result is the occurrence of two reference pulses prior to next tach pulse, and the left to right shift (i.e., in the direction from A to C) of the 0 loaded into stage A of the shift register will be transferred to the second stage on the first reference pulse and to stage C on the second reference pulse. Accordingly, with the absence of a tachometer pulse, all three states of shift register 29 will be at logical 0. The same analysis can be used when

encountering an additional reference pulse, i.e., all three states of shift register 29 will be at logical 0.

In a similar analysis, with the absence of a reference pulse or, alternatively, the addition of an extra tach pulse the two adjacent tach pulses on line 23 will shift right to left the 1 loaded into stage C such that on the occurrence of the first tach pulse stage B will switch to the 1 state, and on the second tach pulse stage A will switch to a logical 1 as well. In such a condition, all three stages of shift register 29 will be in the logical 1 state.

With this analysis, a truth table can be constructed as shown in Figure 5 in which the allowable states for the three stages for proper orientation of the tach and reference pulses result in stage A always being at logical 0, stage C always being at logical 1, and stage B alternating between 0 and 1 continuously. Upon the occurrence of a drop-out of a reference pulse, or addition of a tach pulse, register A will attain a logical 1 state, and likewise with the absence of a tach pulse, or addition of a reference pulse register C will attain a logical 0 state, the later two states being considered improper orientation of the reference and tach pulses for lack of one of the pulses, or presence of an additional pulse of one of the pulse trains.

To detect the improper orientation of the two pulse trains, in effect decoding the presence of a logical 1 in register A or the presence of logical 0 in register C, the output of stage A of shift register 29 is applied on line 71 to inverter 73. The output of inverter 73 is applied along line 75 to NAND gate 79. The other input to NAND gate 79 is an output from stage C of shift register 29 along line 77. The output of NAND gate 79, on line 81, is thus dependent upon the logical states of stages A and C. With inverter 73 in the path of the output of stage A, it can be appreciated that, in the proper orientation with stage A being a 0 and stage C being a 1, both inputs to NAND gate 79 are 1's, and the output at 81 becomes a logical 0. This is indicated in the upper portion of the truth table of Figure 5.

Through similar analysis, when an improper orientation is observed, there are two possibilities as shown in the lower truth table of Figure 5 where the output of both stages A and C are logical 1's or the output of both stages A and C are logical 0's. In either case, one or the other of inputs 75 and 77 of NAND gate 79 will be a logical 0 causing the output 81 to rise to a logical 1 state. Accordingly, the output 81 of NAND gate 79 will remain at 0 for so long as the reference pulses and tachometer pulses are occurring without interruptions and spaced alternately one with the other as shown in Figure 4. However, upon the occurrence of an absence or addition of one or the other of a reference or tach pulse, the output 81 of NAND gate 79 switches to a 1 level, and this represents the indication that an improper orientation has been detected.

The above detection scheme implements the

function $E = \bar{A} \cdot C$, but is not to be limited to it, since its dual $E = A + \bar{C}$ will work equally as well, as one skilled in the art will readily recognize. Reference is made to Figure 3A for the equivalent logical arrangement. In certain cases, it may be desirable that the error detected be indicated by a pulse of a width shorter than the amount of time that the output of NAND gate 79 normally remains high. For example, with the loss of a single tach pulse, the output of NAND gate 79 would remain high until stage C of the shift register is reloaded with a 1 prior to the occurrence of a normal tach pulse. One shot multivibrator 83 is provided to output a signal of a prescribed duration for further processing. In the example shown in Figure 3, the output one line 87 representing the error output from one shot 83 is one second in duration.

It will be appreciated that the circuit of Figure 3 is not frequency sensitive, and hence provides a solution to the problem posed by CLV disc mastering described earlier.

Claims

1. A method of controlling the rotational velocity of a rotating member to rotate said member at a desired velocity, comprising the steps of: providing a drive means for rotating said rotating member; generating a first pulse train representing the instantaneous rotational velocity of said rotating member; generating a reference pulse train having an instantaneous frequency equal to that of said first pulse train when said rotating member is rotating at said desired velocity; providing a three-stage shift register capable of shifting bidirectionally; loading a 0 into the first stage of the shift register; loading a 1 into the third stage of the shift register; shifting the 0 loaded into said first stage toward said third stage with said first pulse train; shifting the 1 loaded into said third stage toward said first stage with said second pulse train, said shifting steps producing, at the output of the second stage of the shift register, a pulse width modulated third pulse train modulated in accordance with the change in time position of the pulses of said first pulse train relative to the pulses of said reference pulse train; and detecting the pulse width modulated output of the second stage of the shift register, and utilizing the detected output to vary the drive to said drive means to effect a change in rotational velocity of said rotating member corresponding to the modulation of said third pulse train.

2. The method as claimed in Claim 1, including the steps of: detecting the presence of like outputs from said first and third stages; and generating an output error signal when like outputs from said first and third stages are detected.

3. An apparatus for controlling the rotational velocity of a rotating member (11) to rotate said member at a desired velocity, comprising: a drive means (51) for rotating said rotating member; means (31) for generating a first pulse train representing the instantaneous rotational velocity of said rotating member; oscillator means (33, 37)

encountering an additional reference pulse, i.e., all three states of shift register 29 will be at logical 0.

In a similar analysis, with the absence of a reference pulse or, alternatively, the addition of an extra tach pulse) the two adjacent tach pulses on line 23 will shift right to left the 1 loaded into stage C such that on the occurrence of the first tach pulse stage B will switch to the 1 state, and on the second tach pulse stage A will switch to a logical 1 as well. In such a condition, all three stages of shift register 29 will be in the logical 1 state.

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Through similar analysis, when an improper orientation is observed, there are two possibilities as shown in the lower truth table of Figure 5 where the output of both stages A and C are logical 1's or the output of both stages A and C are logical 0's. In either case, one or the other of inputs 75 and 77 of NAND gate 79 will be a logical 0 causing the output 81 to rise to a logical 1 state. Accordingly, the output 81 of NAND gate 79 will remain at 0 for so long as the reference pulses and tachometer pulses are occurring without interruptions and spaced alternately one with the other as shown in Figure 4. However, upon the occurrence of an absence or addition of one or the other of a reference or tach pulse, the output 81 of NAND gate 79 switches to a 1 level, and this represents the indication that an improper orientation has been detected.

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function $E = \bar{A} \cdot C$, but is not to be limited to it, since its dual $E = A + \bar{C}$ will work equally as well, as one skilled in the art will readily recognize. Reference is made to Figure 3A for the equivalent logical arrangement. In certain cases, it may be desirable that the error detected be indicated by a pulse of a width shorter than the amount of time that the output of NAND gate 79 normally remains high. For example, with the loss of a single tach pulse, the output of NAND gate 79 would remain high until stage C of the shift register is reloaded with a 1 prior to the occurrence of a normal tach pulse. One shot multivibrator 83 is provided to output a signal of a prescribed duration for further processing. In the example shown in Figure 3, the output one line 87 representing the error output from one shot 83 is one second in duration.

It will be appreciated that the circuit of Figure 3 is not frequency sensitive, and hence provides a solution to the problem posed by CLV disc mastering described earlier.

Claims

1. A method of controlling the rotational velocity of a rotating member to rotate said member at a desired velocity, comprising the steps of: providing a drive means for rotating said rotating member; generating a first pulse train representing the instantaneous rotational velocity of said rotating member; generating a reference pulse train having an instantaneous frequency equal to that of said first pulse train when said rotating member is rotating at said desired velocity; providing a three-stage shift register capable of shifting bidirectionally; loading a 0 into the first stage of the shift register; loading a 1 into the third stage of the shift register; shifting the 0 loaded into said first stage toward said third stage with said first pulse train; shifting the 1 loaded into said third stage toward said first stage with said second pulse train, said shifting steps producing, at the output of the second stage of the shift register, a pulse width modulated third pulse train modulated in accordance with the change in time position of the pulses of said first pulse train relative to the pulses of said reference pulse train; and detecting the pulse width modulated output of the second stage of the shift register, and utilizing the detected output to vary the drive to said drive means to effect a change in rotational velocity of said rotating member corresponding to the modulation of said third pulse train.

2. The method as claimed in Claim 1, including the steps of: detecting the presence of like outputs from said first and third stages; and generating an output error signal when like outputs from said first and third stages are detected.

3. An apparatus for controlling the rotational velocity of a rotating member (11) to rotate said member at a desired velocity, comprising: a drive means (51) for rotating said rotating member; means (31) for generating a first pulse train representing the instantaneous rotational velocity of said rotating member; oscillator means (33, 37)



for generating a reference pulse train having an instantaneous frequency equal to that of said first pulse train when said rotating member is rotating at said desired velocity; a three-stage shift register (29) capable of shifting bidirectionally; means (21) for loading a 0 into the first stage of the shift register; means (22) for loading a 1 into the third stage of the shift register; means (25) for shifting the 0 loaded into said first stage toward said third stage with said first pulse train; means (23) for shifting the 1 loaded into said third stage toward said first stage with said second pulse train, said shifting means producing, at the output of the second stage of the shift register, a pulse width modulated third pulse train modulated in accordance with the change in time position of the pulse of said first pulse train relative to the pulses of said reference pulse train; means (27) for detecting the pulse width modulated output of the second stage of the shift register; and means (67) responsive to the detected output of said second stage to vary the drive to said drive means to effect a change in rotational velocity of said rotating member corresponding to the modulation of said third pulse train.

4. The apparatus as claimed in Claim 3, including: means for detecting the presence of like outputs from said first and third stages; and means for generating an output error signal when like outputs from said first and third stages are detected.

Patentansprüche

1. Ein Verfahren zur Steuerung der Drehgeschwindigkeit eines rotierenden Teils, um das Teil mit einer gewünschten Geschwindigkeit zu drehen, mit den Verfahrensschritten:

Vorsehen einer Antriebseinrichtung zum Drehen des rotierenden Teils; Erzeugen einer ersten Impulsfolge, die die augenblickliche Rotationsgeschwindigkeit des rotierenden Teils repräsentiert; Erzeugen einer Referenzimpulsfolge, mit einer augenblicklichen Frequenz, die gleich derjenigen der ersten Impulsfolge ist, wenn sich das rotierende Teil mit der gewünschten Geschwindigkeit dreht; Vorsehen eines Dreistufenschieberegisters, das eine bidirektionale Verschiebung ermöglicht; Laden einer 0 in die erste Stufe des Schieberegisters; Laden einer 1 in die dritte Stufe des Schieberegisters; Verschieben der in die erste Stufe geladenen 0 zu der dritten Stufe mit ersten Impulsfolge; Verschieben der in die dritte Stufe geladenen 1 zu der ersten Stufe mit der zweiten Impulsfolge, wobei die Verschiebungsschritte am Ausgang der zweiten Stufe der Schieberegisters eine impulsbreitenmodulierte dritte Impulsfolge erzeugen, die entsprechend der Änderung der zeitlichen Position der Impulse der ersten Impulsfolge relativ zu den Impulsen der zweiten Impulsfolge moduliert ist; und Erfassen der impulsbreitenmodulierten Ausgangssignale der zweiten Stufe des Schieberegisters, und Verwenden der erfaßten Ausgangssignale, um den Antrieb der Antriebseinrichtung zu variieren, um

eine Änderung der Drehgeschwindigkeit des rotierenden Teils entsprechend der Modulation der dritten Impulsfolge zu bewirken.

2. Das Verfahren nach Anspruch 1, mit den Verfahrensschritten:

Erfassen der Anwesenheit von gleichen Ausgangssignalen aus der ersten und dritten Stufe; und Erzeugen eines Ausgangsfehlersignals, wenn gleiche Ausgangssignale aus der ersten und dritten Stufe erfaßt werden.

3. Eine Vorrichtung zur Steuerung der Drehgeschwindigkeit eines rotierenden Teils (11), um das Teil mit einer gewünschten Geschwindigkeit zu drehen, mit:

einer Antriebseinrichtung (51) zum Drehen des Drehteils; eine Einrichtung (32) zum Erzeugen einer ersten Impulsfolge, die die augenblickliche Rotationsgeschwindigkeit des Drehteils repräsentiert; einer Oszillatoreinrichtung (33, 37) zum Erzeugen einer Referenzimpulsfolge, mit einer Augenblicksfrequenz, die gleich derjenigen der ersten Impulsfolge ist, wenn sich das Drehteil mit der gewünschten Geschwindigkeit dreht; ein Dreistufenschieberegister (29), das ein bidirektionales Verschieben ermöglicht; eine Einrichtung (21) zum Laden einer 0 in die erste Stufe des Schieberegisters; eine Einrichtung (22) zum Laden einer 1 in die dritte Stufe des Schieberegisters; eine Einrichtung (25) zum Verschieben der in die erste Stufe geladenen 0 zu der dritten Stufe mit der ersten Impulsfolge; eine Einrichtung (23) zum Verschieben der in die dritte Stufe geladenen 1 zu der ersten Stufe mit der zweiten Impulsfolge, wobei die Verschiebeeinrichtung, am Ausgang der zweiten Stufe der Schieberegisters eine impulsbreitenmodulierte dritte Impulsfolge erzeugt, welche in Übereinstimmung mit der Änderung der zeitlichen Position der Impulse der ersten Impulsfolge relativ zu den Impulsen der zweiten Impulsfolge moduliert ist; eine Einrichtung (27) zum Erfassen des impulsbreitenmodulierten Ausgangssignals der zweiten Stufe des Schieberegisters; und eine Einrichtung (67), die auf das erfaßte Ausgangssignal der zweiten Stufe reagiert, um den Antrieb der Antriebseinrichtung zu variieren, um eine Änderung der Drehgeschwindigkeit des Drehteils entsprechend der Modulation der dritten Impulsfolge zu erzeugen.

4. Die Vorrichtung nach Anspruch 3, mit:

einer Einrichtung zum Erfassen der Anwesenheit von gleichen Ausgangssignalen aus der ersten und dritten Stufe; und eine Einrichtung zur Erzeugung eines Ausgangsfehlersignals, wenn gleiche Ausgangssignale aus der ersten und dritten Stufe erfaßt werden.

Revendications

1. Méthode pour commander la vitesse rotationnelle d'un membre tournant pour faire tourner ledit membre à une vitesse souhaitée, comprenant les étapes consistant à: prévoir un moyen d'entraînement pour entraîner en rotation ledit membre tournant: générer un premier train d'im-



pulsions représentant la vitesse rotationnelle instantanée dudit membre tournant; générer un train d'impulsions de référence ayant une fréquence instantanée égale à celle dudit premier train d'impulsions lorsque ledit membre tournant est entraîné en rotation à ladite vitesse désirée; fournir un registre à décalage trois étages capable de décaler de façon bidirectionnelle; charger un "0" dans le premier étage du registre à décalage; charger un "1" dans le troisième étage du registre à décalage; décaler le "0" chargé dans le premier étage vers le troisième étage avec ledit premier train d'impulsions; décaler le "1" chargé dans ledit troisième étage vers ledit premier étage avec le second train d'impulsions, lesdites étapes de décalage produisant, à la sortie du second étage du registre à décalage, un troisième train d'impulsions modulé en largeur d'impulsion modulé en accord avec le changement en position temporelle des impulsions dudit premier train d'impulsions relativement aux impulsions dudit train d'impulsions de référence; détecter la sortie modulée en largeur d'impulsion du second étage du registre à décalage, et utiliser la sortie détectée pour faire varier la commande dudit moyen d'entraînement pour effectuer un changement dans la vitesse rotationnelle dudit membre tournant correspondant à la modulation dudit troisième train d'impulsions.

2. Méthode selon la revendication 1, incluant les étapes suivantes: détecter la présence de mêmes sorties provenant des étapes premier et troisième; et générer un signal d'erreur en sortie lorsque les sorties similaires provenant desdits premier et troisième étages sont détectées.

3. Appareil pour commander la vitesse rotationnelle d'un membre tournant (11) pour entraîner en rotation ledit membre à une vitesse souhaitée, comprenant: un moyen d'entraînement (51) pour entraîner en rotation ledit membre tournant; un moyen (31) pour générer un premier train d'im-

pulsions représentant la vitesse rotationnelle instantanée dudit membre tournant; un moyen oscillateur (33, 37) pour générer un train d'impulsions de référence ayant une fréquence instantanée égale à celle dudit premier train d'impulsions lorsque ledit membre tournant est entraîné en rotation à ladite vitesse souhaitée; un registre à décalage trois étages (29) capable de décaler de façon bidirectionnelle; un moyen (21) pour charger un "0" dans le premier étage du registre à décalage; un moyen (22) pour charger un "1" dans le troisième étage du registre à décalage; un moyen (25) pour décaler le "0" chargé dans ledit premier étage vers ledit troisième étage avec ledit premier train d'impulsions; un moyen (23) pour décaler le "1" chargé dans ledit troisième étage vers ledit premier étage avec le second train d'impulsions, ledit moyen de décalage produisant, à la sortie du second étage du registre à décalage, un troisième train d'impulsions modulé en largeur d'impulsion modulé en accord avec le changement en position temporelle de l'impulsion dudit premier train d'impulsions relativement aux impulsions dudit train d'impulsions de référence; un moyen (27) pour détecter la sortie modulée en largeur d'impulsion du second étage du registre à décalage et un moyen (67) sensible à la sortie détectée dudit second étage pour faire varier la commande dudit moyen d'entraînement pour effectuer un changement dans la vitesse rotationnelle dudit membre tournant correspondant à la modulation dudit troisième train d'impulsions.

4. Appareil selon la revendication 3, incluant: un moyen pour détecter la présence de sorties similaires provenant des étages premier et troisième; et un moyen pour générer un signal d'erreur en sortie lorsque les mêmes sorties provenant desdits premier et troisième étages sont détectées.

