United States Patent Application Publication	20250263978
Kind Code	A1
Publication Date	August 21, 2025
Inventor(s)	Rieper; Norbert et al.

POSITION DETECTION IN AN ELECTRIC DRIVE UNIT FOR CORDS OF BLINDS

Abstract

Techniques include increasing a rotation speed of an electric motor configured to wind the architectural covering over a first time period to a first rotation speed. The techniques further include responsive to the first rotation speed being reached and after the first time period, rotating the electric motor at the first rotation speed for a second time period. The techniques further include after the second time period, increasing the rotation speed of the electric motor over a third time period to a second rotation speed.

Inventors:	**Rieper; Norbert (Rotterdam, NL), Lilienthal; Heiko (Rotterdam, NL)**
Applicant:	**Hunter Douglas Industries B.V.** (Rotterdam, NL)
Family ID:	**1000008589682**
Assignee:	**Hunter Douglas Industries B.V. (Rotterdam, NL)**
Appl. No.:	**19/203555**
Filed:	**May 09, 2025**

Foreign Application Priority Data

NL	NL1041462	Sep. 04, 2015

Related U.S. Application Data

parent US continuation 17246183 20210430 parent-grant-document US 12331589 child US 19203555
parent US continuation 15757615 20180305 parent-grant-document US 11035172 WO continuation PCT/EP2016/070833 20160905 child US 17246183

Publication Classification

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation of U.S. application Ser. No. 17/246,183, filed on Apr. 30, 2021, which is a continuation of U.S. application Ser. No. 15/757,615, filed on Mar. 5, 2018, now U.S. Pat. No. 11,035,172, issued on Jun. 15, 2021, which is a § 371 National Stage of PCT Application No. PCT/EP2016/070833, filed on Sep. 5, 2016, which claims priority to Netherlands Patent Application No. NL1041462, filed Sep. 4, 2015 and published as Netherlands Patent Publication No. NL1041462, the disclosures of which are incorporated by reference herein in their entireties.

FIELD OF THE INVENTION
[0002] The present invention is in the field of blinds being electrically opened/closed, such as e.g. blinds for covering a window in order to provide a protection against sunlight. Especially, the present invention relates to an electric drive unit for cords of blinds, a system comprising such an electric drive unit and a method for operating such an electric drive unit.
BACKGROUND AND OBJECT OF THE INVENTION
[0003] According to the state of the art, e.g. the document U.S. Pat. No. 6,936,987 B2, an electric drive unit is known that comprises a DC driven electric motor for driving a cord winding/unwinding unit for winding/unwinding cords of a blind. The upper end position respectively wound up end position of the cords of the blind is set by mechanical means, such as an abutment, at the top panel respectively header panel comprising the electric motor and the cord winding/unwinding unit. The cord winding/unwinding unit is arranged for winding/unwinding the cords of the blind.
[0004] The wound up end position of the cords of the blind corresponds to the upper end position at which the cords of the blind are wounded up by the electric motor, i.e. at which the blind is opened respectively lifted. When winding up the cords of the blind, i.e. opening or lifting the blind, the blind hits or strikes against the mechanical means at the time of reaching the wound up end position. As a result thereof, the current, which is taken up by the electric motor, increases. This increase of current is detected by a control unit, which stops the electric motor winding up the cords of the blind, regardless of whether a DC voltage is still supplied to the electric motor or not.
[0005] Thus, according to the state of the art, for changing the wound up end position it is necessary to change at the header panel the relative position of the mechanical means.
[0006] Furthermore, the blind being lifted reaches the wound up end position defined by the mechanical means at the header panel with an increased torque, wherein the blind hits or strikes against the mechanical means. This stresses the cords of the blind as well as the mechanical means, the header panel and the blind, which mechanically interact with each other. Over a long time period this stress can cause in particular a weakening of the cords of the blind, as the cords of the blind are always stressed with this high torque at the same position when winding up the cords of

the blind respectively lifting the blind to the wound up end position defined by the mechanical means.

[0007] In view of the above, it is an object of the present invention to propose an electric drive unit for cords of blinds which can overcome these problems. That is, to propose an electric drive unit for cords of blinds that can easily change the wound up end position and reduce the stress on the cords of blinds when winding/unwinding the cords of blinds.

[0008] This object is achieved by an electric drive unit for cords of blinds, a system comprising such an electric drive unit and a method for operating such an electric drive unit according to the independent claims. Advantageous further developments are as set out in dependent claims.

DESCRIPTION OF THE INVENTION

[0009] According to one aspect of the invention an electric drive unit for cords of blinds is proposed, wherein the electric drive unit comprises: [0010] a DC driven electric motor, [0011] a cord winding/unwinding unit driven by the electric motor, for winding/unwinding one or more cords of a blind, [0012] a control circuitry arranged for controlling the operation of the electric motor by controlling the DC supply of the electric motor, the control circuitry being functionally connected to one or more rotation detection sensors, each rotation detection sensor being arranged for detecting increments of the rotation of the electric motor by cooperating with a rotating element driven by the electric motor, the rotating element having at least two discrete elements, wherein the passage of which is detected as detection pulses by the one or more rotation detection sensor, characterized in that the control circuitry is arranged for controlling the electric motor dependent on the time development of the detected passages.

[0013] The control circuitry may be arranged for comparing characteristics (pulse width and/or number of pluses in a defined time window) of one or more passages of different, preferably subsequent, time periods.

[0014] This electric drive unit is advantageous, as no mechanical means are needed for defining a wound up end position. Thus, the wound up end position can easily be changed or adapted and the cords of the blind may be wounded up or the blind may be lifted to the wound up end position without a high stress on the cords of the blind caused by a high torque, when reaching the wound up end position.

[0015] Furthermore, the control circuitry may be arranged for determining the position of the electric motor corresponding to the position of the one or more cords of the blind by counting the number of detection pulses.

[0016] In addition, the control circuitry may be functionally connected to at least two rotation detection sensors, and the control circuitry may be arranged for detecting the direction of the rotation of the electric motor by evaluating the time development, such as e.g. the phase shift of the detection pulses of the two rotation detection sensors.

[0017] Moreover, the control circuitry may be arranged for stopping the operation of the electric motor in case the time development of the detected passages indicates a defined reduction of the speed of rotation of the electric motor.

[0018] Furthermore, the control circuitry may be arranged for determining the speed of rotation of the electric motor by determining the number of detection pulses and/or the pulse width of at least one detection pulse during a time window of defined length, such as e.g. 50 ms.

[0019] In addition, the control circuitry may be arranged for determining an acceleration or deceleration of rotation of the electric motor by determining the number of detection pulses and/or the pulse width of at least one detection pulse during a first time window of defined length, such as e.g. 50 ms, and the number of detection pulses and/or the pulse width of at least one detection pulse during a second time window of the same length as the first time window, wherein a defined difference in the determination results indicates an acceleration or deceleration of rotation of the electric motor.

[0020] Moreover, the control circuitry may be arranged for determining an acceleration or

deceleration of rotation of the electric motor by repeatedly determining the number of detection pulses and/or the pulse width of at least one detection pulse during time windows of defined length, such as e.g. 50 ms, with a defined time period, such as e.g. 200 ms, between one time window and a successive time window, wherein a defined difference between the determination result of the one time window and the determination result of the successive time window indicates an acceleration or deceleration of rotation of the electric motor.

[0021] Furthermore, for winding the one or more cords of the blind up to a defined wound up end position, the control circuitry may be arranged for controlling the electric motor, such that: [0022] the electric motor drives the cord winding/unwinding unit to wind up the one or more cords of the blind, and [0023] the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind at the defined wound up end position and then drives the cord winding/unwinding unit to turn in the opposite direction in order to relax the one or more cords of the blind, or [0024] the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind at a position, which is a defined number of detection pulses, such as e.g. 50 detection pulses, away from the defined wound up end position.

[0025] In addition, for winding the one or more cords of the blind up to a defined wound up end position, the control circuitry may be arranged for controlling the electric motor, such that the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind in case the control circuitry determines a defined reduction of the speed of rotation of the electric motor.

[0026] Further, for winding the one or more cords of the blind up to a defined wound up end position, the control circuitry may be arranged for controlling the electric motor, such that after a defined time period the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind.

[0027] Moreover, for winding or unwinding the one or more cords of the blind, the control circuitry may be arranged for controlling the electric motor, such that [0028] the electric motor accelerates from a rest position to a first speed, [0029] the electric motor then drives the cord winding/unwinding unit at the first speed for a defined time period, [0030] the electric motor then accelerates to a second speed, and [0031] the electric motor then drives the cord winding/unwinding unit at the second speed until the control circuitry controls the electric motor to stop.

[0032] Furthermore, for winding up the one or more cords of the blind, the control circuitry may be arranged for controlling the electric motor, such that [0033] the electric motor drives the cord winding/unwinding unit to wind up the one or more cords of the blind, and [0034] the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind in case the control circuitry determines a defined reduction of the speed of rotation of the electric motor and/or after a defined time period.

[0035] In addition, the blind may be a tensioned blind and, for winding up the one or more cords of the blind to a defined wound up end position, the control circuitry may be arranged for controlling the electric motor, such that, [0036] the electric motor drives the cord winding/unwinding unit to wind up the one or more cords of the blind, and [0037] the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind in case [0038] the control circuitry determines a defined reduction of the speed of rotation of the electric motor and/or [0039] the electric motor reaches an overvalue position, which is a defined distance, such as e.g. 15 cm, in the direction of winding up away from the defined wound up end position, and/or after a defined time period.

[0040] Moreover, the blind may be a tensioned blind and, for unwinding the one or more cords of the blind, the control circuitry may be arranged for controlling the electric motor, such that [0041] the electric motor drives the cord winding/unwinding unit to unwind the one or more cords of the blind, and [0042] the electric motor stops the cord winding/unwinding unit unwinding the one or

more cords of the blind in case the control circuitry determines a defined reduction of the speed of rotation of the electric motor.

[0043] Furthermore, the blind may be a tensioned blind, and, for unwinding the one or more cords of the blind to a defined unwound end position, the control circuitry may be arranged for controlling the electric motor, such that, [0044] the electric motor drives the cord winding/unwinding unit to unwind the one or more cords of the blind, and [0045] the electric motor stops the cord winding/unwinding unit unwinding the one or more cords of the blind in case [0046] the control circuitry determines a defined reduction of the speed of rotation of the electric motor and/or [0047] the electric motor reaches an overvalue position, which is a defined distance, such as e.g. 10 cm, in the direction of unwinding away from the defined unwound end position.

[0048] In addition, in case the control circuitry determines the defined reduction of the speed of rotation of the electric motor before the electric motor reaches the defined unwound end position or the defined overvalue position, the control circuitry may be arranged for setting the position, at which the defined reduction of the speed of rotation of the electric motor is determined, as the defined unwound end position.

[0049] The above optional features may be arbitrarily combined according to the invention.

[0050] According to another aspect of the present invention a system is proposed, wherein the system comprises an electric drive unit for cords of blinds according to the present invention, and one or more cords of at least one blind, wherein the one or more cords of the at least one blind are connected to the cord winding/unwinding unit of the electric drive unit and the electric drive unit is arranged for winding/unwinding the one or more cords of the at least one blind.

[0051] According to a further aspect of the present invention a method for operating an electric drive unit for cords of blinds is proposed, wherein the electric drive unit comprises: [0052] a DC driven electric motor, [0053] a cord winding/unwinding unit driven by the electric motor, for winding/unwinding one or more cords of a blind, and [0054] a control circuitry being functionally connected to one or more rotation detection sensors, each rotation detection sensor being arranged for detecting increments of the rotation of the electric motor by cooperating with a rotating element driven by the electric motor, the rotating element having at least two discrete elements, the passage of which is detected as detection pulses by the one or more rotation detection sensor. According to the method the control circuitry controls the operation of the electric motor by controlling the DC supply of the electric motor, characterized in that the control circuitry controls the electric motor dependent on the time development of the detected passages.

[0055] Furthermore, according to the method, the control circuitry may determine the position of the electric motor corresponding to the position of the one or more cords of the blind by counting the number of detection pulses.

[0056] In addition, the control circuitry may be functionally connected to at least two rotation detection sensors, and according to the method the control circuitry may detect the direction of the rotation of the electric motor by evaluating the time development, such as e.g. the phase shift of the detection pulses of the two rotation detection sensors.

[0057] Moreover, according to the method, the control circuitry may stop the operation of the electric motor in case the time development of the detected passages indicates a defined reduction of the speed of rotation of the electric motor.

[0058] Furthermore, according to the method, the control circuitry may determine the speed of rotation of the electric motor by determining the number of detection pulses and/or the pulse width of at least one detection pulse during a time window of defined length, such as e.g. 50 ms.

[0059] In addition, according to the method, the control circuitry may determine an acceleration or deceleration of rotation of the electric motor by determining the number of detection pulses and/or the pulse width of at least one detection pulse during a first time window of defined length, such as e.g. 50 ms, and the number of detection pulses and/or the pulse width of at least one detection pulse during a second time window of the same length as the first time window, wherein a defined

difference in the determination results indicates an acceleration or deceleration of rotation of the electric motor.

[0060] Moreover, according to the method, the control circuitry may determine an acceleration or deceleration of rotation of the electric motor by repeatedly determining the number of detection pulses and/or the pulse width of at least one detection pulse during time windows of defined length, such as e.g. 50 ms, with a defined time period, such as e.g. 200 ms, between one time window and a successive time window, wherein a defined difference between the determination result of the one time window and the determination result of the successive time window indicates an acceleration or deceleration of rotation of the electric motor.

[0061] Furthermore, according to the method, for winding the one or more cords of the blind up to a defined wound up end position, the control circuitry may control the electric motor, such that:

[0062] the electric motor drives the cord winding/unwinding unit to wind up the one or more cords of the blind, and [0063] the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind at the defined wound up end position and then drives the cord winding/unwinding unit to turn in the opposite direction in order to relax the one or more cords of the blind, or [0064] the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind at a position, which is a defined number of detection pulses, such as e.g. 50 detection pulses, away from the defined wound up end position.

[0065] In addition, according to the method, for winding the one or more cords of the blind up to a defined wound up end position, the control circuitry may control the electric motor, such that the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind in case the control circuitry determines a defined reduction of the speed of rotation of the electric motor

[0066] Further, for winding the one or more cords of the blind up to a defined wound up end position, the control circuitry may control the electric motor, such that after a defined time period the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind.

[0067] Moreover, according to the method, for winding or unwinding the one or more cords of the blind, the control circuitry may control the electric motor, such that [0068] the electric motor accelerates from a rest position to a first speed, [0069] the electric motor then drives the cord winding/unwinding unit at the first speed for a defined time period, [0070] the electric motor then accelerates to a second speed, and [0071] the electric motor then drives the cord winding/unwinding unit at the second speed until the control circuitry controls the electric motor to stop.

[0072] Furthermore, according to the method, for winding up the one or more cords of the blind, the control circuitry may control the electric motor, such that [0073] the electric motor drives the cord winding/unwinding unit to wind up the one or more cords of the blind, and [0074] the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind in case the control circuitry determines a defined reduction of the speed of rotation of the electric motor and/or after a defined time period.

[0075] In addition, the blind may be a tensioned blind and, for winding up the one or more cords of the blind to a defined wound up end position, the control circuitry may control the electric motor, such that, [0076] the electric motor drives the cord winding/unwinding unit to wind up the one or more cords of the blind, and [0077] the electric motor stops the cord winding/unwinding unit winding up the one or more cords of the blind in case [0078] the control circuitry determines a defined reduction of the speed of rotation of the electric motor and/or [0079] the electric motor reaches an overvalue position, which is a defined distance, such as e.g. 15 cm, in the direction of winding up away from the defined wound up end position, and/or after a defined time period.

[0080] Moreover, the blind may be a tensioned blind and, for unwinding the one or more cords of

the blind, the control circuitry may control the electric motor, such that [0081] the electric motor drives the cord winding/unwinding unit to unwind the one or more cords of the blind, and [0082] the electric motor stops the cord winding/unwinding unit unwinding the one or more cords of the blind in case the control circuitry determines a defined reduction of the speed of rotation of the electric motor.

[0083] Furthermore, the blind may be a tensioned blind, and, for unwinding the one or more cords of the blind to a defined unwound end position, the control circuitry may control the electric motor, such that, [0084] the electric motor drives the cord winding/unwinding unit to unwind the one or more cords of the blind, and [0085] the electric motor stops the cord winding/unwinding unit unwinding the one or more cords of the blind in case [0086] the control circuitry determines a defined reduction of the speed of rotation of the electric motor and/or [0087] the electric motor reaches an overvalue position, which is a defined distance, such as e.g. 10 cm, in the direction of unwinding away from the defined unwound end position.

[0088] In addition, according to the method, in case the control circuitry determines the defined reduction of the speed of rotation of the electric motor before the electric motor reaches the defined unwound end position or the defined overvalue position, the control circuitry may set the position, at which the defined reduction of the speed of rotation of the electric motor is determined, as the defined unwound end position.

[0089] The above optional features may be arbitrarily combined according to the invention.

Description

BRIEF DESCRIPTION OF THE FIGURES

[0090] Further advantages, features and characteristics of the present invention will now be described by way of example, with reference to the accompanying drawings, in which:

[0091] FIG. **1** schematically shows an exemplary embodiment of a system comprising an electric drive unit for cords of blinds according to the present invention.

[0092] FIG. **2** schematically shows an exemplary embodiment of an electric drive unit for cords of blinds according to the present invention being connected to a programming box.

[0093] FIG. **3** schematically shows an exemplary embodiment of an electric drive unit for cords of blinds according to the present invention being connected to a programming key.

[0094] FIG. **4** schematically shows an exemplary embodiment of winding/unwinding cords of a blind respectively lifting/lowering a blind by the electric drive unit according to the present invention.

[0095] FIG. **5** schematically shows an exemplary embodiment of a control method for controlling the electric motor of the electric drive unit to start rotating according to the present invention

[0096] FIGS. **6***a* and **6***b* schematically shows two exemplary embodiments of a control method for controlling the electric motor of the electric drive unit to wind the cords of the blind up to the wound up end position A according to the present invention.

[0097] FIG. **7** schematically shows an exemplary embodiment of three different types of blinds being operable by the electric drive unit for cords of blinds according to the present invention.

[0098] FIG. **8** schematically shows an exemplary embodiment of a method performed by the control circuitry for determining the operation mode to operate in.

DETAILED DESCRIPTION OF THE FIGURES

[0099] FIG. **1** schematically shows a system **101** according to the present invention comprising an electric drive unit **104** for cords of blinds and a blind **103**. The blind **103** is attached to the electric drive unit **104**, in particular to the cord winding/unwinding unit **107** of the electric drive unit **104**, by two cords **102***a*. However, according to the invention, the blind **103** may also be attached to the electric drive unit **104** by only one cord **102***a* or more than two cords **102***a*. The cords **102***a*

correspond to lift cords and are wounded/unwounded in order to lift/lower the blind **103**.

[0100] According to FIG. **1** the blind **103** is a free-hanging blind. However the blind **103** can also be a tensioned blind or a venetian blind. A ny blind known to the skilled person, such as e.g. a roller blind, shutter, pleating etc., may be used according to the invention. In addition, according to the invention the electric drive unit **104** may open/close respectively lift/lower more than one blind, wherein the blinds are preferably of the same type.

[0101] Therefore, according to the invention, the system **101** comprises the electric drive unit **104** and one or more cords **102***a* of at least one blind **103**. In the following, the present invention will be described with two cords **102***a* and one blind **103**, wherein the cord winding/unwinding unit is arranged for winding/unwinding the two cords **102***a* of the blind **103**.

Electric Drive Unit

[0102] The electric drive unit **104** comprises a control circuitry **105**, an electric motor **106** and a cord winding/unwinding unit **107**, wherein the control circuitry **105** controls the electric motor **106** to drive the cord winding/unwinding unit **107** for winding/unwinding the two cords **102***a* of the blind **103**. In the following, winding/unwinding the cords **102***a* of the blind **103** corresponds to opening/closing respectively lifting/lowering the blind **103**.

[0103] The control circuitry comprises a central processing unit (CPU) and a power interface (PI), wherein the CPU controls the PI to deliver a defined supply voltage, preferably a DC voltage, to the electric motor **106** for driving the cord winding/unwinding unit **107**. The CPU may be a microcontroller, an A SIC or a hybrid thereof. According to the invention any CPU known to the skilled person may be used. The PI may be any voltage supply unit known by the skilled person that is able to be controlled for delivering a defined voltage to the electric motor **106**.

[0104] The control circuitry **105**, preferably the CPU, receives signals respectively operation signals from an operation unit **112** that may be used by an user for winding/unwinding the cords **102***a* of the blind **103** respectively for lifting/lowering the blind **103**. The operation unit **112** is preferably a rocker switch. For example, in case the upper end (I) of the rocker switch **112** is pressed by a user, the control circuitry **105** controls the electric motor **106** to drive the cord winding/unwinding unit **107**, such that the cord winding/unwinding unit **107** winds the cords **102***a* up, and, thus, the blind **103** is lifted. In case the lower end (II) of the rocker switch **112** is pressed by the user, the control circuitry **105** controls the electric motor **106** to drive the cord winding/unwinding unit **107** in the opposite direction, so that the cord winding/unwinding unit unwinds the cords **102***a* and, thus, the blind **103** is lowered. Of course the switch assignment can be the other way around and any operation unit **112** known to the skilled person for controlling the winding/unwinding of the cords **102***a* of the blind **103** may be used according to the invention.

[0105] The operation unit **112** may also comprise a function according to which the cords **102***a* of the blind **103** may be wounded from the current position to the wound up end position A or unwounded from the current position to the unwound end position B.

[0106] For example, when the upper end (I) of the operation unit **112** is pressed by a user for a defined time, the control circuitry **105** controls the electric motor **106** to drive the cord winding/unwinding unit **107**, such that the cords **102***a* of the blind **103** are wounded up from the current position to the wound up end position A. That is the blind **103** is lifted from the current position to the wound up end position A, at which the blind **103** is opened or lifted up. Thus, in case the lower end (II) of the operation unit **112** is pressed by the user for a defined time, the control circuitry **105** controls the electric motor **106** to drive the cord winding/unwinding unit **107**, such that the cords **102***a* of the blind **103** are unwounded from the current position to the unwound end position B. That is the blind **103** is lowered from the current position to the unwound end position B, at which the blind **103** is closed or shut down.

[0107] In the following the wound up end position A corresponds to the upper end position, at which the cords **102***a* of the blind **103** are wound up, such that the blind **103** is opened or lifted up and the unwound end position B corresponds to the lower end position, at which the cords **102***a* of

the blind **103** are unwound, such that the blind **103** is closed, shut down or lowered. Preferably, at the wound up end position A the cords **102***a* of the blind **103** are wound up, such that the blind **103** is completely opened or lifted up and at the unwound end position B the cords **102***a* of the blind **103** are unwound, such that the blind **103** is completely closed, shut down or lowered.

[0108] As shown in FIG. **1**, the control circuitry **105** is functionally connected to a programming interface **113** and a voltage supply interface **115**.

[0109] The programming interface **113** is arranged for being electrically and mechanically coupled to a programming tool, such as e.g. a programming box **117** or a programming key **120**. Preferably, the programming interface comprises at least three pins or input pins **114** for receiving signals or programming signals from the programming tool for programming the control circuitry **105**, preferably the CPU.

[0110] The voltage supply interface **115** is arranged for being electrically and mechanically coupled to a voltage source **116**, preferably a DC voltage source supplying a DC-voltage of e.g. 24V. Preferably, the voltage supply interface **115** comprises at least two pins or input pins for taking up the voltage, preferably the DC-voltage, from the voltage source **116**.

[0111] According to the invention, the electric drive unit **104** may also comprise only a voltage supply interface **115** without a separate programming interface **113**. In such a case, the voltage supply interface **115** still receives the supply voltage, preferably DC-voltage, from the voltage source **116**. Moreover, the voltage supply interface **115** may receive programming signals for programming the control circuitry **105**, preferably the CPU, wherein the programming signals correspond to a defined modulation of the supply voltage. Thus, the voltage supply interface **115** corresponds in such a case to a programming interface receiving the supply voltage and programming signals as a modulation of the supply voltage. Therefore, according to the invention, the control circuitry **105** may receive via the programming interface programming signals and a supply voltage, wherein the programming signals correspond to a defined modulation of the supply voltage.

[0112] According to the invention, both the CPU and the power interface PI are supplied with voltage and, thus, with electric energy from the voltage supply interface **115**, wherein the CPU controls the power interface PI for providing or supplying the voltage to the electric motor **106**. That is, the CPU controls the amount of voltage supplied to the electric motor **106**, the time, at which the voltage is supplied to the electric motor **106**, and/or the time or time period, for which or during which the voltage is supplied to the electric motor **106**.

[0113] As already mentioned, according to the invention, any means and method known to the skilled person for supplying a voltage respectively electric energy to an electric motor **106**, wherein the supply is controlled by a control circuitry, preferably CPU, may be used.

[0114] Preferably, the control circuitry **105** comprises energy storage means **111**, such as e.g. capacitors, for providing electric energy/power to the control circuitry **105**, in particular the CPU and power interface PI, in case the voltage supply via the voltage supply interface **115** is interrupted. As a result thereof, parameters and settings, such as e.g. the wound up end position A, the unwound end position B, the current position of the cords **102***a* respectively the blind **103**, the mode of operation etc., used by the control circuitry **105**, preferably the CPU, for controlling the electric motor **106** and stored in a storage (not shown in FIG. **1**) associated with the control circuitry **105**, preferably the CPU, may be maintained, in case the voltage supply of the control circuitry **105** via the voltage supply interface **115** is interrupted or stopped. According to the invention, the energy storage means **11** do not need to be part of the control circuitry **105** as shown in FIG. **1** and, thus, may be provided differently in the electric drive unit **204**.

[0115] The electric motor **106** is a DC driven electric motor, preferably an electric motor driven with a DC-voltage of 24V. The direction of rotation as well as the speed of rotation of the electric motor **106** is controlled by the control circuitry **105**, preferably the CPU. According to the invention any DC driven electric motor known to the skilled person may be used.

[0116] The cord winding/unwinding unit **107** is driven by the electric motor **106**. That is the direction of rotation of the electric motor **106** determines whether the cord winding/unwinding unit **107** winds or unwinds the cords **102***a* of the blind **103** and the speed of rotation of the electric determines at which speed the cord winding/unwinding unit winds or unwinds the cords **102***a* of the blind **103**.

[0117] The electric drive unit **104** for cords of blinds, comprising the control circuitry **105**, the electric motor **106** and the cord winding/unwinding unit **107**, may be installed/arranged in the top panel or header panel of a blind system. Since there are certain industrial norms which e.g. define the arrangement of the cords **102***a* of the blind **103**, the control circuitry **105** and the electric motor **106** are preferably provided at the side, in the sideward space towards a first cord **102***a*, of the header panel. This space at the side of the header panel has e.g. a length of about 135 mm.

[0118] Moreover, the circuit board of the control circuitry **105** has preferably a u-shaped form, wherein the means **111** for storing electrical energy, such as e.g. capacitors, are preferably arranged on the inner side of the u-shaped circuit board, facing to the inner side of the u-shape. Namely, such an arrangement is space-saving.

Position Detection

[0119] According to the present invention the control circuitry **105** may detect or determine the current position of the electric motor **106** and, thus, may detect or determine the current position of the cords **102***a* or the blind **103**.

[0120] As shown in FIG. **1**, a shaft **107***a* of the cord winding/unwinding unit **107** is extended from the rotor **106***a* of the electric motor **106**, preferably in the direction of the control circuitry **105**. The shaft **107***a* is connected to a rotating element **109**, preferably a disk, comprising eight discrete elements **110**, which are preferably magnetized sectors. According to the invention the rotating element **109** comprises at least two discrete elements **110**, i.e. the rotating element **109** may comprise only two discrete elements **110** or more than two discrete elements **110**. The rotating element **109** is arranged, such that two rotation detection sensors **108**, preferably hall sensors, can detect the rotation of the eight discrete elements **110** of the rotating element **109**, when the rotor **106***a* of the electric motor **106** and, thus, the extended shaft **107***a* rotates. According to the invention more than two rotation detection sensors **108** may also be provided.

[0121] The control circuitry **105**, especially the CPU, is functionally connected to the two rotation detection sensors **108**. According to FIG. **1** the two rotation detections sensors **108** are provided on the control circuitry **105**. However, according to the invention, the two rotation detection sensors **108** may also not be part of the control circuitry **105**.

[0122] When the electric motor **106** rotates, the rotating element **109** also rotates. Each time a discrete element **110** passes a rotation detection sensor **108**, the corresponding rotation detection sensor **108** detects the passage of this discrete element as a pulse or detection pulse. That is the rotation detection sensor **108** generates and transmits a detection pulse to the control circuitry **105**, preferably the CPU, each time a discrete element **110** of the rotating element **109** passes by.

[0123] Thus, the control circuitry **105**, preferably the CPU, may determine the position of the electric motor **106** corresponding to the position of the cords **102***a* of the blind **103** by counting the number of detection pulses provided by the rotation detection sensors **108**. That is the current position of the blind **103** being wounded or unwounded may be determined by the control circuitry **105** by counting the number of detection pulses.

[0124] This corresponds to a digital coding (rotational coding) of the position of the electric motor **106**, as preferably the control circuitry **105** receives a detection peak respectively detection pulse each time a discrete element **110** passes a rotation detection sensor **108**, i.e. each time a magnetized/magnetic sector **110** passes a hall sensor **108**.

[0125] Preferably, the discrete elements **110** on the rotating element **109** are alternately magnetized, as shown in FIG. **1**.

[0126] Thus, the position of the electric motor **106** respectively the position of the cords **102***a* and

the blind **103** is coded by the count or number of detection pulses respectively peaks of the signals received from the rotation detection sensors **108**. This corresponds to a rotation code.

[0127] The control circuitry **105** stores the count of detection pulses representing the current position of the electric motor **106** in the storage associated with the control circuitry **105**, when the electric motor **106** stops rotating.

[0128] Therefore, the control circuitry **105** may control the electric motor **106** by counting the detection pulses received from the rotation detection sensors **108**. That is the control circuitry **105** may control the electric motor **106** on the basis of the time development of the detected passages, as the passage of the discrete elements **110** at the rotation detection sensors **108** is detected by the rotation detection sensors **108** as detection pulses.

Detection of the Direction of Rotation

[0129] In order to detect or determine the direction of rotation of the electric motor and, thus, to determine, whether the cords **102***a* of the blind **103** are wound up or unwounded, the two rotation detection sensors **108**, preferably hall sensors, have a different polarity and/or are arranged, such that the signals from the detection rotation sensors **108** are phase-shifted to each other. That is the signals, comprising a peak or detection pulse for each time a discrete element **109** passes by the corresponding detection rotation sensor **108**, are phase-shifted to each other. Therefore, the control circuitry **105**, preferably the CPU, may determine on the basis of the phase-shift between the two signals received from the two rotation detection sensors **108** the direction of rotation of the electric motor **106**. Thus, the control circuitry **105** may know whether the cords **102***a* of the blind are wounded up or unwounded.

Programming Box

[0130] FIG. **2** schematically shows an exemplary embodiment of the electric drive unit **204** for cords of blinds according to the present invention being connected to a programming box. The system **201** and electric drive unit **204** correspond to the system **101** and electric drive unit **104** of FIG. **1**, respectively and, thus, the above description is also valid for the exemplary embodiment according to FIG. **2**. The last two numbers of the reference signs of the components of FIG. **2** correspond to the last two numbers of the reference signs of the components of FIG. **1**. In the following, mainly new features or details with respect to the exemplary embodiment of FIG. **1** are described, in order to avoid unnecessary repetition.

[0131] As already mentioned the programming interface **213** of the electric drive unit **204** may be electrically and mechanically coupled to a programming tool. As shown in FIG. **2**, for example a programming box **217** may be electrically and mechanically coupled or connected to the electric drive unit **204** as a programming tool. The programming box **217** is coupled to the electric drive unit **204** outside the normal operation state of the electric drive unit **204** for programming purposes. Namely, during the normal operation state, the electric drive unit **204**, particularly the control circuitry **205**, is controlled by the operation unit **212**. For programming purposes, i.e. for programming the control circuitry **205**, preferably the CPU, the programming box **217** is preferably connected between the electric drive unit **204**, preferably the programming interface **113** and voltage supply interface **215**, and the voltage source **216**.

[0132] The programming box **217** comprises two switches **218** and **219**. The switch **218** is preferably a turn-switch that can be switched or turned to select one out of the four programming states "A", "B", "OFF" and "X". According to the invention any means know to the skilled person for selecting one out of four programming states may be used for the switch **218**. The switch **219** is preferably a rocker switch for controlling the electric motor **206** to drive the cord winding/unwinding unit **207** to wind/unwind the cords **202***a* of the blind **203**, as described already above with respect to the operation unit **212**. Of course any means known to the skilled person for controlling the winding/unwinding of the cords **202***a* of the blind **203** may be used for the switch **219**.

[0133] The control circuitry **205** may be connected via the programming interface **213** to the

programming box **217** in order to receive programming signals for programming, determining or setting parameters or settings of the control circuitry **205** for controlling the electric motor **206**, such as e.g. the wound up end position A, the unwound end position B, an intermediate position of the cords **202***a* of the blind **203**, an operation mode, a scheme for controlling the speed of rotation of the electric motor **206**, a set value or set point for the speed of rotation etc. An intermediate position corresponds to a position between the wound up end position A and the unwound end position B, at which the blind is neither fully opened or lifted nor fully closed or lowered.

[0134] Preferably, the programming box does not comprise any actual electronic except of interface elements, such as switches or rocker switches. These interface elements may be used to selectively short-circuit the three pins or programming pins **214** of the programming interface **213**. For example in case the switch **218** is set or turned to the position of the programming state "B" respectively position "B", as shown in FIG. **2**, the corresponding pin or programming pin **214** of the programming interface **213** is short-circuited, so that the control circuitry **205** knows that the programming signals received via the programming interface **213** from the programming box **217** correspond to the programming state "B". This is the same for the programming states "A" and "X".

[0135] In the programming state "OFF", i.e. when the switch **218** is turned or set to the programming state "OFF", none of the pins **214** of the programming interface **213** are short circuited and the control circuitry **205**, preferably, does not receive or see any programming signals.

[0136] In the programming state "A" the wound up end position A may be programmed or set and in the programming state "B" the unwound end position B and an intermediate position of the cords **202***a* or the blind **203** may be programmed or in case an intermediate position is already set, the intermediate position may be deleted. In the programming state "X" the connection between the programming box **217** and the electric drive unit **204** may be tested or checked, and the operation mode of the electric drive unit **304** may be programmed or set. Furthermore, in the programming state "X" the operation mode respectively the electric drive unit (**204**), preferably the control circuitry (**205**), may be reset to the delivery condition, wherein the end positions, i.e. the wound up end position A and the unwound end position B, as well as a possibly set intermediate position stored in the storage associated with the control circuitry **205** are preferably deleted.

[0137] An intermediate position of the cords **202***a* of the blind **203** corresponds to a position between the wound up end position A and the unwound end position B, at which the blind is neither fully opened or lifted nor fully closed or lowered.

[0138] The operation mode of the electric drive unit **304** corresponds to the type of blind that is opened/closed by the electric drive unit **204**. Preferably, there are three defined operation modes according to which the electric drive unit **204** is able to operate. These three operation modes correspond preferably to operating a free hanging blind, a tensioned blind and a venetian blind, respectively. According to the invention, there may also be only two defined operation modes or more than three defined operation modes according to which the electric drive unit **204** is able to operate. The different operation modes may not only vary in the type of blind being operated, i.e. being opened/closed, by the electric drive unit **204**. For example the operation modes may also vary in the control of the speed of rotation of the electric motor **206**.

[0139] Preferably, the programming box **217** is used by the manufacturer to program or set parameters of the control circuitry **205** for controlling the electric motor **206**, such as the wound up end position A and the unwound end position B.

[0140] Preferably, the operation unit **212** is not usable for winding/unwinding the cords **202***a* of the blind **203**, when the programming box **217** is connected to the electric drive unit **204** for programming the control circuitry **205**, preferably the CPU.

[0141] When connecting the programming box **217** to the electric drive unit **204**, i.e. to the programming interface **213** and voltage supply interface **215**, the voltage supply of the control

circuitry **205** from the voltage source **216** is interrupted for a certain time. As mentioned already above, energy storage means **111**, such as e.g. capacitors, provided in the electric drive unit **204** may preferably supply the control circuitry **205** with voltage respectively electric energy during this time, until the voltage is supplied again from the voltage source **216** via the programming box **217** and the voltage supply interface **215** to the control circuitry **205**.

Programming Key

[0142] FIG. **3** schematically shows an exemplary embodiment of the electric drive unit **204** for cords of blinds according to the present invention being connected to a programming key. The system **301** and electric drive unit **304** correspond to the system **101** and electric drive unit **104** of FIG. **1** and the system **201** and electric drive unit **204** of FIG. **2**, respectively. Thus, the above description is also valid for the exemplary embodiment according to FIG. **3**. The last two numbers of the reference signs of the components of FIG. **3** correspond to the last two numbers of the reference signs of the components of FIGS. **1** and **2**. In the following, mainly new features or details with respect to the exemplary embodiment of FIGS. **1** and **2** are described, in order to avoid unnecessary repetition.

[0143] As already mentioned, the programming interface **313** of the electric drive unit **304** may be electrically and mechanically coupled to a programming tool. As shown in FIG. **3**, for example a programming key **320** may be electrically and mechanically coupled or connected to the electric drive unit **304** as a programming tool. The programming key **320** is, preferably, coupled to the electric drive unit **204** during the normal operation state of the electric drive unit **204** for programming purposes.

[0144] As already mentioned, the programming box **217** is preferably used by the manufacturer to program or set parameters of the control circuitry **205** for controlling the electric motor **206**, such as the wound up end position A and the unwound end position B. The programming key is preferably used when installing or reinstalling the blind **303** and the electric drive unit **304** (the electric drive unit being installed in the header panel of the blind system **301**) for programming a change of especially the unwound end position B. That is the programming key **320** may be used at the place of use of the electric drive unit **304**, such as e.g. at home or office, by the customer in order to program or adapt the unwound end position B.

[0145] Therefore, when the programming key **320** is connected to the programming interface **313** (as shown in FIG. **3**), the programming key **320** selectively short-circuits the input pin or programming pin **314** of the programming interface **313** that is provided for programming the unwound end position B. That is the programming key **320** short-circuits the programming pin **314** that is provided for receiving programming signals indicating the unwound end position B. For winding/respectively unwinding the cords **302***a* of the blind **303** when the programming key **320** is connected to the programming interface **313**, the operation unit **312** may be used. In contrast to the programming with the programming box **217**, as shown in FIG. **2**, the control circuitry **305** is directly supplied with voltage via the voltage supply interface **315** from the voltage source **316**, as it is the case during the normal operation state.

General Operation of the Electric Drive Unit During the Normal Operation State

[0146] FIG. **4** schematically shows an exemplary embodiment of winding/unwinding cords of a blind respectively lifting/lowering a blind by the electric drive unit according to the present invention. The above description is also valid for the exemplary embodiment according to FIG. **4**. The last two numbers of the reference signs of the components of FIG. **4** correspond to the last two numbers of the reference signs of the components of FIGS. **1** to **3**. In the following, mainly new features or details with respect to the exemplary embodiment of FIGS. **1** to **3** are described, in order to avoid unnecessary repetition.

[0147] According to FIG. **4**, depending on the direction of rotation of the electric motor **406** the cord winding/unwinding unit **407** is driven to wind/unwind the cords **402***a* of the blind **403**. On the left side of FIG. **4**, the cords **402***a* of the blind **403** are wound up to the wound up end position A

and the blind **403** is fully opened or lifted up. However, according to the invention, the blind **403** does not have to be fully opened or lifted up, when the cords **402***a* of the blind **403** are wound up to the wound up end position A.

[0148] Preferably, the control circuitry **405** (not shown in FIG. **4**) of the electric drive unit **404** (not fully shown in FIG. **4**) sets the wound up end position A to the reference point with e.g. the value or count 0. Therefore, when the cords **402***a* being in the wound up end position A are unwounded, the control circuitry **405** counts the detection pulses, received from the rotation detection sensors **408** (not shown in FIG. **4**) as a result of the rotation of the electric motor **406**, starting from the value or count 0 until the electric motor **406** stops rotating. That is, the control circuitry **405** increments the value or count for each detection pulse received from a corresponding rotation detection sensor **408**, when the cords **402***a* of the blind **403** are unwounded. The count is then stored by the control circuitry **405** in the storage associated with the control circuitry **405**.

[0149] When the control circuitry **405** controls the electric motor **406** to rotate again, the stored count is read or loaded in order for the control circuitry **405** to know or determine the current position of the cords **402***a* of the blind **403** at the time of the electric motor **406** starting to rotate again.

[0150] In case the electric motor **406** rotates, such that the cord winding/unwinding unit **407** further unwinds the cords **402***a*, the control circuit further increments the count for each detection pulse received from a corresponding rotation detection sensor **408**. However, in case the electric motor **406** rotates in the opposite direction, i.e. the cord winding/unwinding unit **407** winds the cords **402***a* up, the control circuitry decrements the count for each detection pulse received from a corresponding rotation detection sensor **408**.

[0151] The change in the direction of rotation of the electric motor **406**, i.e. the change from unwinding to winding the cords **402***a* of the blind **403** or vice versa, may be determined by the control circuitry **405**, as according to the invention the rotation of the electric motor **406** is detected by at least two rotation detection sensors **408**, preferably hall sensors.

[0152] As already described above, the at least two rotation detection sensors **408** have a different polarity and/or are arranged, such that the signals, i.e. the detection pulses, received from these two rotation detection sensors **408** are phase-shifted to each other. Thus, the control circuitry **405** may know or determine a change in the direction of rotation of the electric motor **406** on the basis of this phase-shift.

[0153] In the middle of the FIG. **4** the cords **402***a* of the blind **403** are at an intermediate position between the wound up end position A and the unwound end position B. Preferably, the count corresponding to such an intermediate position is greater than the count corresponding to the wound up end position A, which is preferably 0, but is smaller than the count corresponding to the unwound end position B. When the cords **402***a* are unwounded starting from the intermediate position the count is incremented by the control circuitry **405** for each detection pulse received from a corresponding rotation detection sensor **408**. When the cords **402** are wounded up starting from the intermediate position the count is decremented by the control circuitry **405** for each detection pulse received from a corresponding rotation detection sensor **408**.

[0154] On the right side of FIG. **4**, the cords **402***a* of the blind **403** are unwounded to the unwound end position B and the blind **403** is fully closed or lowered. However, according to the invention, the blind **403** does not have to be fully closed or lowered, when the cords **402***a* of the blind **403** are unwounded to the unwound end position B.

[0155] According to the invention the control circuitry **405** of the electric drive unit may also set the wound up end position B or any other intermediate position to the reference point with e.g. the value or count 0.

Detection of the Speed of Rotation of the Electric Motor

[0156] For the following description, references are made again to FIG. **1**, i.e. the reference signs of FIG. **1** are used again.

[0157] According to the invention the control circuitry **105**, preferably the CPU, may detect or determine the speed of rotation of the electric motor **106** and, thus, may determine the speed at which the cord winding/unwinding unit **107** winds/unwinds the cords **102***a* of the blind **103**.

[0158] For determining the speed of rotation of the electric motor **106**, the control circuitry **105** counts or determines the number of detection pulses received during a time window of defined length. The time window has a defined length or duration of preferably 50 ms. Therefore, the control circuitry **105** determines on the basis of the frequency of the signals, i.e. the detection pulses, received from the rotation detection sensors **108**, the speed of rotation of the electric motor **106**. Moreover, the control circuitry **105** may determine the pulse width of at least one detection pulse during the time window of defined length in order to determine the speed of rotation of the electric motor **106**.

Detection of a Change in the Speed of Rotation of the Electric Motor

[0159] Furthermore, the control circuitry **105**, preferably the CPU, may detect or determine a change in the speed of rotation of the electric motor **106**, i.e. an increase or reduction of the speed of rotation of the electric motor **106** corresponding to an acceleration or deceleration of rotation of the electric motor **106**. Therefore, the control circuitry **105** may determine an acceleration or deceleration of the winding/unwinding of the cords **102***a* of the blind **103** by the cord winding/unwinding unit **107**.

[0160] For determining the acceleration or deceleration of rotation of the electric motor **106**, the control circuitry **105** determines or counts the number of detection pulses received during two time windows of the same defined length or duration, which is preferably 50 ms. A defined difference in the two determination results indicates an acceleration or deceleration of rotation of the electric motor. For example, in case the number of detection pulses determined or counted by the control circuitry **105** during a first time window of a defined length is greater by a defined value, such as e.g. 10 detection pulses, than the number of detection pulses determined or counted by the control circuitry **105** during a successive second time window of the same defined length, the control circuitry **105** determines that the speed of rotation of the electric motor **106** has been reduced. The difference between the determination result of the first time window and the determination result of the second time window is a measure for the increase or reduction of the speed of rotation of the electric motor **106**. That is, if the difference between the two determination results is great, then the change in the speed of rotation of the electric motor **106** is also great.

[0161] The control circuitry **105** may also determine the acceleration or deceleration of rotation of the electric motor **106** by determining the pulse width of at least one detection pulse during two time windows of the same defined length or duration, which is preferably 50 ms. A defined difference in the two determination results indicates an acceleration or deceleration of rotation of the electric motor **106**.

[0162] According to the invention, the control circuitry **105** determines that the speed of rotation of the electric motor **106** has changed, i.e. increased or decreased, in case there is a significant difference between the number of detection pulses counted by the control circuitry **105** during a first time window of defined length and the number of detection pulses counted by the control circuitry **105** during a second successive time window of the same length. That is, the control circuitry **105** determines that the speed of rotation of the electric motor **106** has changed, in case the frequency of the detection pulses during the first time window significantly differs from the frequency of the detection pulses during the second time window. Between the first and second time window, there is preferably a defined time period, of e.g. 200 ms, during which no determination or detection of the speed of rotation of the electric motor **106** is carried out by the control circuitry **105**.

[0163] Preferably, the control circuitry **105** repeatedly determines the number of detection pulses and/or the pulse width of at least one detection pulse during time windows of defined length, such as e.g. 50 ms, with a defined time period, such as e.g. 200 ms, between one time window and a

successive time window, wherein a defined difference or significant difference between the determination result of the one time window and the determination result of the successive time window indicates an acceleration or deceleration of rotation of the electric motor **106**. A significant difference corresponds e.g. to a value of 10 detection pulses respectively a predefined difference in the pulse width.

[0164] Thus, the control circuitry **105** determines whether the number of detection pulses received from the rotation detection sensors **108** and/or the pulse width has changed in two successive time windows of defined length in order to determine whether the speed of rotation of the electric motor **106** has changed.

[0165] This is a very fast and sensitive detection of the speed of rotation of the electric motor **106** and a change of the speed of rotation of the electric motor **106**. A detection of the speed of rotation of the electric motor with the same accuracy and temporal resolution using a detection of the current being consumed (taken up) by the electric motor **106** would be more expensive and space consuming. Namely, expensive and space consuming electronics is required for such a detection of the current.

[0166] Moreover, the rotating element **109** having preferably eight discrete magnetic elements of alternating polarity allows the control circuitry **105** to detect or determine the speed of rotation and a change of the speed of rotation of the electric motor **106** at such a high frequency, as described above.

Control of the Speed of Rotation

[0167] Preferably, the control circuitry **105**, in particular the CPU, controls the speed of rotation of the electric motor **106** in a feed forward control, wherein the speed of rotation profile of the electric motor **106** is set or determined by a current profile. That is, the control circuitry **105** controls the voltage supplied to the electric motor **106** in order to control the speed of rotation of the electric motor **106**.

[0168] For example, the CPU of the control circuitry **105** may deliver a PWM (pulse width modulated) signal to the power interface PI for determining or setting the voltage to be supplied to the electric motor **106**. Preferably, by increasing the PWM signal, i.e. increasing the on-time (t.sub.ON) or duty cycle (t.sub.ON/T, wherein T is the period of the PWM signal) of the PWM signal, the voltage supplied from the control circuitry **105**, preferably the power interface PI, to the electric motor **106** is increased. Therefore, when the CPU increases the on-time (t.sub.ON) respectively the duty cycle (t.sub.ON/T) of the PWM signal delivered to the power interface PI, the voltage supplied to the electric motor **106** is increased and, thus, the speed of rotation of the electric motor **106** increases.

[0169] However, according to the invention the control circuitry, preferably the CPU, may also control the speed of rotation of the electric motor **106** in a feed back control. Namely, as described already above, the speed of rotation of the electric motor **106** is repeatedly determined by the control circuitry in successive time windows of define length, with a defined time period of no detection between the time windows. Thus the control circuitry, preferably the CPU, may control the actual value of the speed of rotation to a set value respectively target value of speed of rotation. The control circuitry may preferably perform a control algorithms in order to set the actual value of the speed of rotation to a set value.

Speed of Rotation when Starting the Electric Motor from Rest

[0170] Generally, according to the invention, the control circuitry **105** controls the electric motor **105** to start rotating at a low speed of rotation. That is in case the electric motor is at rest, i.e. does not rotate, the control circuitry **105** controls the electric motor **106**, such that the electric motor starts to rotate at a lower speed of rotation compared to the speed of rotation normally used for driving the cord winding/unwinding unit to wind/unwind the cords **102***a* of the blind **103**.

[0171] In the following, the control of the speed of rotation of the electric motor **106** when starting the electric motor **106** from rest is described with respect to FIG. **5**: At the beginning the electric

motor **106** is at rest, i.e. the electric motor is not rotating and thus the cords **102***a* of the blind **103** are neither wounded up nor unwounded (step **501**). For starting the electric motor **106** from rest the control circuitry **105**, preferably the CPU, increases the voltage supplied to the electric motor **106** until the electric motor **106** starts rotating (step **502**). Preferably, the voltage supplied to the electric motor **106** is increased by increasing the duty cycle (t.sub.ON/T) or on-time (to) of the PWM signal delivered from the CPU to the power interface PI. That is, the control circuitry **105** increases the duty cycle (t.sub.ON/T) or on-time (t.sub.ON) of the PWM signal in order to increase the voltage supplied to the electric motor **106** and, thus, the speed of rotation of the electric motor **106**.

[0172] Next the control circuitry **105** controls the electric motor **106** to increase the speed of rotation during a first acceleration phase until a first speed of rotation is reached (step **503**) and then controls the electric motor **106** to keep rotating at this first speed of rotation for a defined time (step **504**). After this defined time, the control circuitry **105** controls the electric motor **106** to further increase the speed of rotation during a second acceleration phase until a second speed of rotation is reached (step **505**). This second speed of rotation is higher than the first speed of rotation and corresponds to the normal speed of rotation of the electric motor **106** for driving the cord winding/unwinding unit **107** to wind/unwind the cords **102***a* of the blind **103**. The electric motor **106** continues to rotate at the second speed of rotation until the control circuitry controls the electric motor **106** to stop rotating (step **506**).

[0173] The increase of the speed of rotation is achieved by the control circuitry **105** by increasing the voltage supplied to the electric motor **106**. Preferably, the increase of the voltage supplied to the electric motor **106** is achieved by increasing the duty cycle or on-time of the PWM signal delivered to the power interface PI of the control circuitry **105**. Generally, when the control circuitry **105** controls the electric motor **106** to start rotating and, thus, to start driving the cord winding/unwinding unit to wind/unwind the cords **102***a* of the blind **103**, the control circuitry **105** controls the electric motor **106** to first rotate at a lower speed of rotation for a defined time before rotating at the normal speed of rotation used for winding/unwinding the cords **102***a*.

Control Methods for Winding the Cords of the Blind Up to the Wound Up End Position A

[0174] According to the invention the wound up end position A is defined by the manufacturer and/or may be programmed using a programming tool at a later stage, such as e.g. when installing the electric drive unit **104** and/or the blind **103**. The wound up end position A is one of the parameters stored in a storage associated with the control circuitry **105** and used by the control circuitry **105** for controlling the electric motor **106**.

[0175] When a user operates or instructs the control circuitry **105** via the operation unit **112** or the switch **119** of the programming box **117** to wind up the cords **102***a*, the control circuitry **106** performs the control method shown in FIG. **6***a*.

[0176] At first the control circuitry determines the current position of the cords **102***a* (step **601***a*) by reading or loading the count of detection pulses, stored in the storage (associated with the control circuitry) the last time the electric motor stopped rotating. Namely, as described already above, the wound up end position may be set as the reference point with a count of 0 and when winding/unwinding the cords **102***a* the count of detection pulses is decremented/incremented each time detection pulses are received from the rotation detection sensors **108**.

[0177] Next the control circuitry **105** controls the electric motor **106** to start rotating, such that the cord winding/unwinding unit **107** is driven to wind the cords **102***a* of the blind **103** up (step **602***a*). During the winding of the cords **102***a* the control circuitry **105** determines or checks repeatedly whether the current position of the cords **102***a* corresponds to the defined wound up end position A (step **603***a*).

[0178] In case the current position of the cords **102***a* does not correspond to the wound up end position A (NO at step **603***a*), the control circuitry **106** controls the electric motor **106** to keep rotating (step **602***a*) and, thus, winding the cords **102***a* up. Furthermore, the control circuitry keeps checking whether the current position of the cords **102***a* corresponds to the wound up end position

A (step **603***a*).

[0179] In case the current position of the cords **102***a* corresponds to the wound up end position A or in case the control circuitry **105** detects an obstacle or blockade by e.g. detecting a defined reduction of speed of rotation of the electric motor **106** (YES at step **603***a*), the control circuitry **105** controls the electric motor **106** to stop rotating and stores the count in the storage (step **604***a*). In the first case, the count corresponds to 0, since the cords **102***a* have reached the wound up end position A, which is preferably the reference point with a value or count of 0.

[0180] Next, the control circuitry **105** controls the electric motor **106** to shortly rotate or turn in the opposite direction compared with the direction of rotation for winding the cords **102***a* up, in order to relax the cords **102***a* and the blind **103** (step **605***a*). That is, the control circuitry **105** controls the electric motor **106** to rotate in the direction for unwinding the cords **102***a* of the blind **103** for a defined number or count of detection pulses. Thus, the relaxing of the cords **102***a* may be programmed by the manufacturer by setting the number or count of detection pulses of the rotation code for which the electric motor **106** has to rotate in the direction of unwinding the cords **102***a*.

[0181] After the relaxation step **605***a*, the control circuitry **105** controls the electric motor to stop rotating and saves the count of detection pulses indicating the current position of the cords **102***a* (step **606***a*).

[0182] For winding the cords **102***a* up to the wound up end position A, the control circuitry **105** may also control the electric motor **106** according to the control method of FIG. **6***b*. According thereto, the cords **102***a* are wound up to a position, which is a defined number or count of detection pulses, such as e.g. 50 detection pulses, below the wound up end position A.

[0183] At first the control circuitry determines the current position of the cords **102***a* (step **601***b*) by reading or loading the count of detection pulses, stored in the storage (associated with the control circuitry) the last time the electric motor stopped rotating. This corresponds to the step **601***a* of FIG. **6***a*.

[0184] Next the control circuitry **105** controls the electric motor **106** to start rotating, such that the cord winding/unwinding unit **107** is driven to wind the cords **102***a* of the blind **103** up (step **602***b*). This corresponds to the step **602***a* of FIG. **6***a*.

[0185] During the winding of the cords **102***a* the control circuitry determines or checks repeatedly whether the current position of the cords **102***a* corresponds to the position, which is a defined number or count of detection pulses below the wound up end position A (step **603***b*).

[0186] In case the current position of the cords **102***a* does not correspond to this position below the wound up end position A (NO at step **603***b*), the control circuitry **106** controls the electric motor **106** to keep rotating (step **602***b*) and, thus, winding the cords **102***a* up. Furthermore, the control circuitry keeps checking whether the current position of the cords **102***a* corresponds to the defined position below the wound up end position A (step **603***b*).

[0187] In case the current position of the cords **102***a* corresponds to the wound up end position A (YES at step **603***b*), the control circuitry **105** controls the electric motor **106** to stop rotating and stores the count in the storage (step **604**).

[0188] The above described control methods according to FIGS. **6***a* and **6***b* for winding the cords **102***a* up to the wound up end position A prevent the cords **102***a* as well as the blind **103** to be mechanically stressed, as a result of being wounded up or kept in place at the wound up end position A under a high tension.

[0189] In addition, for winding the cords **102***a* up to the wound up end position A, the control circuitry may also control the electric motor **106**, such that the electric motor **106** stops the cord winding/unwinding unit **107** after a defined time or time period, such as e.g. 3 minutes. That is, in case the cords **102***a* do not have reached the wound up end position A respectively a defined position below the wound up end position A after a defined time of e.g. 3 minutes, the control circuitry **105** controls the electric motor **106** to stop rotating. This allows to stop the electric motor **106** rotating after a defined time, in case e.g. the cords **102***a* are teared or have been ripped, i.e. the

wound up end position A respectively the defined position below the wound up end position A is never reached.

Different Types of Blinds

[0190] As mentioned already above, the electric drive unit **104** according to the present invention may operate in different defined operation modes. Preferably, this means that the electric drive unit **104** is able to operate at least three different types of blinds.

[0191] In this regard, FIG. **7** schematically shows an exemplary embodiment of three different types of blinds being operable by the electric drive unit **104** according to the present invention. The last two numbers of the reference signs of the components of FIG. **7** correspond to the last two numbers of the reference signs of the components of FIGS. **1** to **4**.

Free-Hanging Blind

[0192] On the left side of FIG. **7** the blind **703** is a free-hanging blind, wherein the blind **703** is lifted/lowered by winding/unwinding the cords or lift cords **702***a* of the blind **703**. The blind is lifted due to the torque produced when the electric motor **706** drives the cord winding/unwinding unit to wind the cords **702***a* of the blind **703** up. The blind **703** is passively lowered. Namely, when the electric motor **706** drives the cord winding/unwinding unit to unwind the cords **702***a* of the blind **703**, the blind **703** being a free-hanging blind is lowered due to the own weight being pulled down by gravity.

Tensioned Blind

[0193] In the middle of FIG. **7** the blind **703** is a tensioned blind. Such a blind is characterized in that the lowering or closing of the blind **703** is not carried out passively by gravity as described above with regard to the free-hanging blind, but the lowering or closing of the blind **703** is carried out actively by second cords **702***b*. According to the invention at least one second cord **702***b* must be provided. For the following description, it will be assumed that two second cords **702***b* are provided, as shown in the middle of FIG. **7**.

[0194] The second cords **702***b* are attached at the lower end part of the blind **703** and are also wounded/unwounded by the cord winding/unwinding unit **707**. Preferably, the second cords **702***b* are deflected by deflection sheaves or pulleys **702***c* at the bottom panel and directed to the cord winding/unwinding unit **707**. According to the invention any means known to the skilled person that wind/unwind the second cords **702***b* in response to the electric motor **706** rotating to unwind/wind the cords **702***a* may be used. That is, when the cords or lift cords **702***a* are wounded/unwounded the second cords **702***b* are unwounded/wounded, respectively. The lower end part of the blind **703** corresponds to the end part of the blind **703** facing the unwound end position B. The bottom panel is the panel of the blind system that is arranged at the side of the unwound end position B.

[0195] Preferably, the tensioned blind **703** is installed in a frame, wherein the header panel or top panel comprising the electric drive unit **704** (not fully shown in FIG. **7**) is provided at the top side of the frame, i.e. at the side of the frame that is above the wound up end position A. The bottom panel, preferably comprising the deflection sheaves respectively pulleys **702***c* or other means for winding/unwinding the second cords **702***b*, is provided at the bottom side of the frame, i.e. at the side of the frame that is below the unwound end position B.

[0196] When the electric motor **706** rotates in order to lower the tensioned blind **703**, the blind **703** is released under a certain tension as a result of unwinding the cords **702***a* and at the same time the blind **703** is pulled down in the direction of the unwound end position B by the second cords **702***b*, which are wounded up by the electric motor **706**, in particular the cord winding/unwinding unit **707**.

[0197] The cords **702***a* and the second cords **702***b* are not fixed or bound to the cord winding/unwinding unit **707**, preferably the winding shaft of the cord winding/unwinding unit **707**, but they are attached to the cord winding/unwinding unit **707** due to friction. Namely, the cords **702***a* and second cords **702***b* are wounded, enlaced or wrapped around the winding shaft of the cord

winding/unwinding unit **707** for several enlacements, such as e.g. **11** enlacements. As a result the cords **702***a* and second cords **702***b* are attached to the cord winding/unwinding unit **707** due to the friction caused by the enlacements.

Venetian Blind

[0198] On the right side of FIG. **7** the blind **703** is a venetian blind. Such a blind is characterized by horizontal lamellas **703***a*, which are equally spaced from each other and can be rotated or turned in order to change the opening angle. The lamellas **703***a* are preferably made of aluminum, but any other material, such as plastic, wood etc., may also be used. The alignment or orientation respectively the position of the lamellas **703***a* may be changed by ladder cords **702***d*, which are provided in addition to the cords or lift cords **702***a* being wounded/unwounded to lift/lower the blind **703**. That is the ladder cords **702***d* are provided for changing the opening angle of the horizontal lamellas **703***a* of the blind **703**. According to the invention at least one ladder cord **702***d* must be provided for the venetian blind. For the following description, it will be assumed that two ladder cords **702***d* are provided, as shown on the right of FIG. **7**.

Programming of the Electric Drive Unit

[0199] As mentioned already above, the electric drive unit **104** is arranged for being electrically and mechanically coupled to a programming tool, such as e.g. the programming box **117** and the programming key **120**, in order for being programmed. In detail, the programming interface **113** may be connected to a programming tool, in order to program parameters or settings of the control circuitry **105**, which are used by the control circuitry **105**, preferably the CPU, for controlling the electric motor **106**.

[0200] These parameters or settings are e.g. the wound up end position A, the unwound end position B, an intermediate position, a set speed of rotation, a control scheme for controlling the speed of rotation of the electric motor **106**, an operation mode indicating e.g. what type of blind is being opened/closed etc.

[0201] In the following a programming of the control circuitry **105**, preferably the CPU, is exemplarily described by using the programming box **117** and the programming key **120**. However, any other programming tool may be used to perform the programming of the control circuitry according to the present invention.

Initialization of the Programming Mode

[0202] After having connected the programming box **117** to the electric drive unit as described above with regard to FIG. **2**, the user may check whether the programming box **117** is properly connected to the programming interface **113** of the electric drive unit **104**. For this, the user turns the switch **118** in the position "X" and presses the switch **119** for a defined time, preferably for several seconds. In case the programming box **117** is properly connected to the programming interface **113**, the control circuitry **105** controls the electric motor **106** according to a defined or preprogrammed short control scheme, in order to indicate the proper connection to the user.

[0203] Preferably, the control circuitry **105** also deletes any preprogrammed positions, such as e.g. the wound up end position A and the unwound end position B, in the storage associated with the control circuitry **105**, in case of a proper connection between the programming box **117** and the programming interface **113**. Namely, when programming the control circuitry **105**, preferably, the user programs both the wound up end position A and the unwound end position B.

Determination of the Polarity of the Electric Motor for Reaching the End Positions

[0204] As a result of programming or setting the wound up end position A and the unwound end position B using the programming tool, the control circuitry **105**, preferably the CPU, learns the respective polarity of the supply voltage respectively the direction of rotation of the electric motor **106** for reaching these two end position. That is the control circuitry **105** learns or gets to know the direction of rotation of the electric motor **106** respectively the polarity of the supply voltage for winding the cords **102***a* of the blind **103** up to the wound up end position A and the direction of rotation of the electric motor **106** respectively the polarity of the supply voltage for unwinding the

cords **102***a* of the blind **103** to the unwound end position B.

[0205] Therefore, in case the electric motor **106** is not installed in the header panel at the predefined position, such as e.g. the electric motor is installed on the right side instead of the left side of the header panel, or the polarity of the wiring is interchanged, the control circuitry **105** may internally adapt the assignment of the polarity of the supply voltage respectively the direction of rotation of the electric motor **106** with respect to winding/unwinding the cords **102***a* of the blind **103**.

[0206] As a result, the electric drive unit **104**, especially the electric motor **106**, may be installed in the header panel any way around, as the control circuitry **105** learns during the programming of the two end positions A and B the necessary polarity of the supply voltage respectively direction of rotation of the electric motor **106** for reaching these end positions.

Programming the Operation Mode

[0207] As already mentioned above, the electric drive unit **104**, preferably the control circuitry **105**, is arranged for operating according to at least two, preferably three, defined operation modes. For the following description, it will be assumed that the electric drive unit **104** is arranged for operating in three defined operation modes, wherein the three defined operation modes correspond to "operating a free-hanging blind", "operating a tensioned blind" and "operating a venetian blind", respectively.

[0208] Preferably, the operation mode set by the manufacturer corresponds to "operating a free-hanging blind". The user may however change the operation mode using the programming box **117**.

[0209] For setting the operation mode of the control circuitry **105** from "operating a free-hanging blind" to "operating a tensioned blind" the user operates the switch **119** (while the switch **118** is in the "OFF" position), such that the cords **102***a* of the blind **103** are unwounded to the (currently set) unwound end position B. That is the electric motor **106** respectively the cords **102***a* are driven to the unwound end position B. When the electric motor **106** respectively the cords **102***a* are at the unwound end position B, the user switches the switch **118** from the "OFF" position to the "X" position and then presses the switch **119** for a defined time, preferably one second, while the switch **118** is in the "X" position. This indicates to the control circuitry **105** that the operation mode is changed from "operating a free-hanging blind" to "operating a tensioned blind". After this the user turns the switch **118** again to the "OFF" position.

[0210] For setting the operation mode of the control circuitry **105** from "operating a free-hanging blind" to "operating a venetian blind" the user operates the switch **119** (while the switch **118** is in the "OFF" position"), such that the cords **102***a* of the blind **103** are wounded up to the (currently set) wound up end position A. That is the electric motor **106** respectively the cords **102***a* are driven to the wound up end position A. When the electric motor **106** respectively the cords **102***a* are at the wound up end position A, the user switches the switch **118** from the "OFF" position to the "X" position and then presses the switch **119** for a defined time, preferably one second, while the switch **118** is in the "X" position. This indicates to the control circuitry **105** that the operation mode is changed from "operating a free-hanging blind" to "operating a venetian blind". After this the user turns the switch **118** again to the "OFF" position.

[0211] Therefore, the control circuitry **105** is arranged for determining the operation mode on the basis of programming signals received via the programming interface **113** and the position of the cords **102***a* or electric motor **106** at the time of receiving the programming signals. The determination method performed by the control circuitry **106** when receiving a programming signal for programming the operation mode is schematically shown in FIG. **8**. In detail, the control circuitry **105** determines, whether the programming signals are received for a defined time via the input pin **114** for inter alia setting the operation mode (steps **801** and **802**) and determines the current position of the cords **102***a* (step **803**).

[0212] In case the programming signals are received for a defined time corresponding to a programming of the operation mode via the input pin **114** for inter alia programming the operation

mode, the control circuitry **105** determines that the operation mode is to be changed or programmed.

[0213] Next, the control circuitry determines the current position of the cords **102***a* or the electric motor **106**. In case the current position corresponds to the unwound end position B, the control circuitry **105** sets the operation mode to "operating a tensioned blind" (step **804***b*). In case the current position corresponds to the wound up end position A, the control circuitry **105** sets the operation mode to "operating a venetian blind" (step **804***a*).

[0214] Preferably, the operation mode is maintained to be "operating a tensioned blind" or "operating a venetian blind", once the control circuitry **105** is programmed to one of these two operation modes. In such a case, the operation mode may be changed back again to the preferable initial operation mode "operating a free-hanging blind" respectively may be reset to the delivery condition as a result of a factory-reset.

[0215] Preferably, the operation mode may also be reset to the delivery condition respectively changed back again to the initial operation mode, preferably the operation mode "operating a free-hanging blind", by the user. For this the user switches the switch **118** from the "OFF" position to the "X" position and then presses the switch **119** for a defined time, preferably six second, while the switch **118** is in the "X" position. This indicates to the control circuitry **105** that the operation mode is reset to the delivery condition. After this the user preferably turns the switch **118** again to the "OFF" position. As a result thereof, the end positions, i.e. the wound up end position A and the unwound end position B, as well as a possibly set intermediate position stored in the storage associated with the control circuitry **205** are preferably deleted. In this regard it is noted that resetting or changing back the operation mode to the delivery condition corresponds to resetting the electric drive unit **104**, preferably the control circuitry **105**, to the delivery condition.

[0216] When programming or setting the operation mode of the control circuitry **105** to the defined operation mode "operating a venetian blind", two predefined settings of the opening angle of the lamellas at the unwound end position B may be programmed, such as e.g. an opening angle of 90° and an opening angle of 0°. A venetian blind with an opening angle of the lamellas of 0° at the unwound end position B, comprises lamellas that are completely closed, i.e. a minimum amount of light can pass through the venetian blind, as the spaces between the single lamellas are closed by the lamellas. A venetian blind with an opening angle of the lamellas of 90° at the unwound position B, comprises lamellas that are completely opened, i.e. a maximum amount of light can pass through the venetian blind, as the spaces between the lamellas are maximally opened.

[0217] The user may choose between these two predefined settings of the opening angle of the lamellas by multiply pressing the switch **119** for a defined time, while the switch **118** is in the "X" position and the cords **102***a* of the blind **103** are in the wound up end position A (steps **804***a*, **805** and **806**). For example, when pressing the switch **119** an even number of times the opening angle of the lamellas at the unwound end position B is 0° (step **808**) and when pressing the switch **119** an uneven number of times the opening angle is 90° (step **807**).

Programming Wound Up End Position A

[0218] For programming the wound up end position A, the user turns the switch **118** from the "OFF" position to the "A" position and presses the switch **119**, such that the cords **102***a* are wounded up and the blind **103** is lifted. When the blind **103** reaches the header panel, the speed of rotation of the electric motor **106** is reduced and the current consumed by the electric motor **106** as well as the torque increase significantly.

[0219] The control circuitry **105** determines this reduction of the speed of rotation on the basis of counting the detection pulses received from the rotation detection sensors **108** during time windows of defined length, as described above. In addition, the control circuitry **105** may determine the significant increase of current and torque. In response to determining or detecting the reduction of the speed of rotation of the electric motor **106** and, preferably, the significant increase in current and torque, the control circuitry **105** stops the electric motor **106** and stores the position of the

cords **102***a* at the time of stopping the electric motor **106** as the wound up end position A in the storage associated with the control circuitry **105**. At the end the user turns the switch **118** from the "A" position back to the "OFF" position.

[0220] Therefore, when the control circuitry **105**, preferably the CPU, receives programming signals via the programming interface **113**, the control circuitry determines from which pin **114** of the programming interface the programming signals are received. In case the programming signals are received from the pin **114** for programming the wound up end position A, the control circuitry determines that the wound up end position A is to be programmed. The pin **114** for programming the wound up end position A corresponds to the pin **114** that is short-circuited, when the switch **118** is in the "A" position. Thus, when the control circuit determines that the speed of rotation of the electric motor **106** reduces while the cords **102***a* are winded up, the control circuitry **105** controls the electric motor **106** to stop and programs the position at which the electric motor is stopped as the wound up end position A.

[0221] Therefore, the position, at which the blind **103** is completely lifted up, is preferably programmed as the wound up end position A.

Programming Unwound End Position B for First Time

[0222] For programming the unwound end position B for the first time, the user turns the switch **118** from the "OFF" position to the "B" position and presses the switch **119**, such that the cords **102***a* are unwound and the blind **103** is lowered to a desired position for the unwound end position B.

[0223] When pressing the switch **119**, the speed of rotation of the electric motor **106** increases from a lower speed of rotation to a defined speed of rotation for winding/unwinding the cords **102***a* of the blind **103**. In order to drive to a desired position for the unwound end position "B at a lower speed of rotation, the pressing of the switch **119** may be interrupted. When the switch **119** is then pressed again, the electric motor **106** rotates again at the lower speed of rotation.

[0224] When the desired position is reached, the pressing of the switch **119** is stopped and the user switches the switch **118** from the position "B" back to the position "OFF". As a result thereof, the control circuitry **105** saves the current position of the cords **102***a* respectively the blind **103**, which is the desired position, as the unwound end position B.

[0225] When the control circuitry **105**, preferably the CPU, receives programming signals via the programming interface **113**, the control circuitry determines from which pin **114** of the programming interface the programming signals are received. In case the programming signals are received from the pin **114** for programming the unwound end position B, the control circuitry determines that the unwound end position B is to be programmed. The pin **114** for programming the unwound end position B corresponds to the pin **114** that is short-circuited, when the switch **118** is in the "B" position. Thus, when the desired position is reached and the control circuitry **105** does not receive any more programming signals, as the switch **118** is turned from the position "B" to the position "OFF", the control circuitry stores the current position of the cords **102***a* as the unwound end position B.

Reprogramming Unwound End Position B

[0226] For reprogramming the unwound end position B, the user operates the switch **119** (while the switch **118** is in the "OFF" position"), such that the cords **102***a* of the blind **103** are unwounded to the (currently set) unwound end position B. That is the electric motor **106** respectively the cords **102***a* are driven to the unwound end position B. When the electric motor **106** respectively the cords **102***a* are at the unwound end position B, the user switches the switch **118** from the "OFF" position to the "B" position and then operates the switch **119** (while the switch **118** is in the "B" position), such that the cords **102***a* of the blind **103** are wounded/unwounded to the desired position for the new unwound end position B.

[0227] When the desired position for the new unwound end position B is reached, the operating of the switch **119** is stopped and the user switches the switch **118** from the position "B" back to the

position "OFF". As a result thereof, the control circuitry **105** saves the current position of the cords **102***a* respectively the blind **103**, which is the desired position, as the new unwound end position B.

[0228] Thus, the control circuitry determines on the basis of the programming signals and the position of the cords **102***a* at the time of receiving the programming signals the new unwound end position B.

Programming Unwound End Position B for a Tensioned Blind

[0229] The above described methods for programming/reprogramming the unwound end position B are preferably performed by the control circuitry **105** when operating in the operation modes "operating a free-hanging blind" and "operating a venetian blind".

[0230] When the control circuitry **105** operates in the operation mode "operating a tensioned blind", a slightly different method is performed. In the following references are made with regard to FIG. **7**.

[0231] Namely, since for a venetian blind the cords **702***a* and the second cords **702***b* are not fixed to the cord winding/unwinding unit **707**, but are attached to the cord winding/unwinding unit **707** by friction due to winding or wrapping the cords **702***a* and the second cords **702***b* around the winding shaft of the cord winding/unwinding unit **707** for several times, a slip or slippage is possible.

[0232] As a result thereof, an absolute position may not be defined, as the relative position of the cords **702***a* and the second cords **702***b* to the cord winding/unwinding unit **707**, especially the winding shaft, may change due to such a slip or slippage.

[0233] This problem is relatively small, when the blind **703** reaches the wound up end position A or the header panel, as the cords **702***a* are mostly wound up and, thus, a high friction is present keeping the cords **702***a* and the blind **703** in position. Therefore, the wound up end position A, may be programmed as described above. That is, preferably the wound up end position A is programmed for all three defined operation modes in the same way.

[0234] However, when the control circuitry **105** operates in the operation mode "operating a tensioned blind", the following method is performed (references are made with regard to FIG. **1**):

[0235] For programming the unwound end position B for the first time, the user switches the switch **118** from the "OFF" position to the "B" position and operates then the switch **119**, such that the electric motor **106** unwinds the cords **102***a*. When reprogramming the unwound end position B, the user first drives the blind **103** in the set unwound end position B. After having reached the set unwound end position B, the user switches the switch **118** from the "OFF" position to the "B" position and operates then the switch **119**, such that the electric motor **106** unwinds the cords **102***a*.

[0236] When the blind **103** reaches the unwound end position B/new unwound end position B, the speed of rotation of the electric motor reduces and the current consumed by the electric motor **106** as well as the torque raises significantly. The control circuitry **105** determines or detects this reduction of the speed of rotation and preferably also detects the significant increase of current and/or torque. As a result thereof, the control circuitry **105** stops the electric motor **106** and saves the position of the cords **102***a* or the blind **103** at the time of stopping the electric motor **106** as the unwound end position B/new unwound end position B.

[0237] Therefore, the electric drive unit **104**, preferably the control circuitry **105** determines a parameter of the control circuitry **105** or electric motor **106**, such as e.g. the unwound end position B, on the basis of the programming signals received at the programming interface **113**, the operation mode set at the time of receiving the programming signals, and the position of the cords **102***a* or electric motor **106** at the time of receiving the programming signals.

Programming the Opening Angle of the Lamellas of a Venetian Blind at the Unwound End Position B

[0238] According to the invention, the opening angle of the lamellas of a venetian blind being unwound at the unwound end position B may be programmed. Thus, when the venetian blind is fully closed respectively lowered, i.e. the cords **102***a* are unwound to the unwound end position B,

an opening angle of the lamellas may be programmed so that still light can pass through the openings between the lamellas. The amount of light passing through the venetian blind depends on the opening angle. In case of an opening angle of 0°, no light passes through, as the lamellas are turned such that the openings between the lamellas are closed. In case of an opening angle of 90°, a maximum amount of light may pass through, as the lamellas are turned such that the openings between the lamellas are not closed by the lamellas.

[0239] For programming the opening angle, the user turns the switch **118** from the position "OFF" to the position "X" and operates then the switch **119**, while the switch **118** is in the position "X", for setting the opening value. For example the opening angle of the lamellas may be programmed through pressing the switch **119** for a defined time period and/or pressing the switch **119** for a defined number of times. Thus, e.g. different time periods may correspond to different opening angles.

Unwinding a Tensioned Blind to the Unwound End Position

[0240] When a tensioned blind is unwounded to the end position B, the control circuitry may control the electric motor **106**, such that electric motor **106** drives the cord winding/unwinding unit to unwind the cords **102***a* and to wind up the second cords **102***b* (not shown in FIG. **1**). The control circuitry **106** controls the electric motor **106** to stop rotating, in case the control circuitry **106** detects or determines a defined reduction of the speed of rotation of the electric motor **106**. Preferably, the control circuitry **106** may also control the electric motor **106** to stop rotating, in case of detecting a defined increase of the current of the electric motor **106**. Moreover the control circuitry **105** controls the electric motor **106** to stop rotating, in case the electric motor **106** or the cords **102***a* reach an overvalue position 0V (not shown in FIG. **1**, but in FIG. **7**), which is a defined distance, such as e.g. 10 cm, below the unwound end position B. That is, the overvalue position 0V is a defined distance, in the direction of the unwinding, away from the unwound end position B.

[0241] Preferably, in case the control circuitry **105** determines or detects the defined reduction of the speed of rotation of the electric motor **106** and/or, preferably, the defined increase of the current of the electric motor **106** before the electric motor **106** or the cords **102***a* reach the unwound end position B or the defined overvalue position 0V, the control circuitry **105** sets the position, at which the defined reduction of the speed of rotation and/or the defined increase of the current is determined, as the new unwound end position B.

[0242] The control circuitry might determine a defined reduction of the speed of rotation and/or a defined increase of the current before reaching the unwound end position B or the overvalue position, as a result of an obstacle being present. For example this could be a plant pot on a windowsill that prevents the blind **103** from further lowering.

[0243] According to the present invention, the control circuitry **105** controls the electric motor **106** on the basis of determining or detecting the speed of rotation of the electric motor **106**. A control on the basis of the current consumed or taken up by the electric motor may be implemented as an additional feature.

Winding a Tensioned Blind Up to the Wound Up End Position

[0244] Preferably, the above control scheme can also be performed when the cord winding/unwinding unit **107** winds the cords **102***a* of the blind **103** being a tensioned blind up to the wound up end position A. In this case, the control circuitry **105** controls the electric motor **106** to stop rotating, in case the control circuitry **106** detects or determines a defined reduction of the speed of rotation of the electric motor **106**. Preferably, the control circuitry **106** may also control the electric motor **106** to stop rotating, in case of detecting a defined increase of the current of the electric motor **106**. Moreover the control circuitry **105** controls the electric motor **106** to stop rotating, in case the electric motor **106** or the cords **102***a* reach an overvalue position OV**2**, which is a defined distance, such as e.g. 15 cm, above the wound up position A. That is, the overvalue position OV**2** is a defined distance, in the direction of the winding up, away from the wound up end position A.

[0245] Furthermore, as mentioned already above, the control circuitry **105** may also control the electric motor **106**, such that the electric motor **106** stops rotating after a defined time, such as e.g. 3 minutes. That is, in case the cords **102**a neither reach the wound up end position A nor the overvalue position OV**2** after a defined time, such as e.g. 3 minutes, the control circuitry **105** controls the electric motor **106** to stop rotating.

[0246] Preferably, in case the control circuitry **105** determines or detects the defined reduction of the speed of rotation of the electric motor **106** and/or, preferably, the defined increase of the current of the electric motor **106** before the electric motor **106** or the cords **102**a reach the wound up end position A or the defined overvalue position OV**2**, the control circuitry **105** sets the position, at which the defined reduction of the speed of rotation and/or the defined increase of the current is determined, as the new wound up end position A.

[0247] According to the present invention, the control circuitry **105** controls the electric motor **106** on the basis of determining or detecting the speed of rotation of the electric motor **106**. A control on the basis of the current consumed or taken up by the electric motor may be implemented as an additional feature.

Determining an Obstacle when Winding Up a Free-Hanging Blind or a Venetian Blind

[0248] When the control circuitry **105** operates in the "operating a free-hanging blind" operation mode or the "operating a venetian blind" operation mode, the control circuitry **105** may detect an obstacle, when winding up the blind **103** being a free-hanging blind or a venetian blind. In case the control circuitry **105** detects or determines that an obstacle is present, it stops the electric motor **106** rotating and, thus, stops the cord winding/unwinding unit winding the cords **102**a of the blind **103** up.

[0249] The control circuitry **105** determines that an obstacle is present, in case the control circuitry **105** determines or detects a defined reduction of the speed of rotation of the electric motor **106** and/or a defined increase of the current of the electric motor **106**. As a result thereof, the control circuitry **105** controls the electric motor **106** to stop rotating.

Relaxing the Blind after Reaching the Wound Up End Position A

[0250] As already described above with regard to FIG. **6**a, after the cords **102**a or the blind **103** has reached the wound up end position A, the control circuitry **105** may control the electric motor **106** to shortly rotate or turn in the opposite direction compared with the direction of rotation for winding the cords **102**a up, in order to relax the cords **102**a and the blind **103**.

[0251] Such a relaxation of the cords **102**a and the blind **103** may preferably also be performed after the control circuitry **105** has controlled the electric motor **106** to stop rotating in response to determining or detecting an obstacle.

[0252] For free-hanging blinds and venetian blinds, the cords **102**a and the blind **103** are always relaxed by the same relaxation value, i.e. the electric motor **106** rotates or turns in the opposite direction for the same short time period.

[0253] Preferably, for tensioned-blinds, the cords **102**a and the blind **103** are relaxed by a relaxation value depending on the total length of the blind **103**. That is the time period for which the electric motor **106** rotates in the opposite direction depends on the total length of the blind **103**.

[0254] The dependency on the length may be implemented as a percentage value or different relaxation categories.

[0255] Tensioned-blinds are often used in environments with a certain humidity. A sticking together of the several segments, such as e.g. the pleating-folds, of the blind **103** in the wound up end position A due to the interaction of high temperature, humidity etc. may be prevented as a result of relaxing the blind **103** with a relaxation value depending on the total length of the blind **103**. Namely, due to the relaxation after reaching the wound up end position A, the single segments of the blind **103** are detached or disengaged again from each other. When reaching the wound up end position A, the single segments of the blind **103** are stacked together, like a package.

[0256] Furthermore, as a result of the relaxation a drying of the blind **103** may be achieved due to a

good air circulation or ventilation.

Reprogramming of the Unwound End Position B Using the Programming Key

[0257] As mentioned already above, the programming key may be used by a user to reprogram the unwound end position B.

[0258] For this, the user operates the operation unit **112**, such that the electric drive unit **104** unwinds in the normal operation state the cords **102***a* of the blind **103** to the unwound end position B. In detail, the control circuitry **105**, preferably the CPU, controls the electric motor **106** to rotate such, that the cord winding/unwinding unit unwinds the cords **102***a* of the blind **103** to the unwound end position B.

[0259] When the cords **102***a* respectively the blind **103** is at the unwound end position B, the user connects the programming key **120** to the programming interface **113**, which short-circuits the input pin **114** for programming the unwound end position B. Next, the user operates the operation unit **112** in order to drive the cords **102***a* or the blind **103** to the new desired unwound end position B. After the cords **102***a* respectively the blind **103** is at the desired position for the new unwound end position B, the user disconnects the programming key **120**. As a result thereof, the control circuitry stores the position at which the programming key is disconnected as the new unwound end position B in the storage associated with the control circuitry **105**.

Programming of an Intermediate Position Using the Programming Key

[0260] Furthermore, the programming key may be used by a user to program an intermediate position. Preferably, an intermediate position is programmed for venetian blinds, wherein the electric motor **106**, operating a venetian-blind, stops at the intermediate position, in order to rotate for a defined time in the opposite direction compared with the direction of rotation before the stop, such that the lamellas are opened to a defined opening angle. The opening angle may be set by the defined time, for which the electric motor rotates in the opposite direction.

[0261] For programming the intermediate position, the user operates the operation unit **112**, such that the electric drive unit **104** drives, i.e. wind/unwinds, in the normal operation state the cords **102***a* of the blind **103** to the desired intermediate position. In detail, the control circuitry **105**, preferably the CPU, controls the electric motor **106** to rotate such, that the cord winding/unwinding unit winds/unwinds the cords **102***a* of the blind **103** to the desired intermediate position.

[0262] When the cords **102***a* respectively the blind **103** is at the desired intermediate position, the user connects the programming key **120** to the programming interface **113**, which short-circuits the input pin **114** for programming the unwound end position B. Next, the user presses the switch of the operation unit **112** for a defined time, preferably one second, and then disconnects the programming key **120**. As a result thereof, the control circuitry stores the position at which the programming key is disconnected as the intermediate position in the storage associated with the control circuitry **105**.

Deleting an Intermediate Position Using the Programming Key

[0263] In order to delete an intermediate position, the user operates the operation unit, such that the electric drive unit **104** winds up in the normal operation state the cords **102***a* of the blind **103** to the wound up end position A. In detail, the control circuitry **105**, preferably the CPU, controls the electric motor **106** to rotate such that the cord winding/unwinding unit winds up the cords **102***a* of the blind **103** to the wound up end position A.

[0264] When the cords **102***a* respectively the blind **103** is at the wound up end position A, the user connects the programming key **120** to the programming interface **113**, which short-circuits the input pin **114** for programming the unwound end position B. Next, the user presses the switch of the operation unit **112** for a defined time, preferably one second, and then disconnects the programming key **120**. As a result thereof, the control circuitry deletes the intermediate position stored in the storage associated with the control circuitry **105**.

Programming with the Programming Key

[0265] As described above, when the programming key is connected to the programming interface

113 and the control circuitry **105** receives signals from the operation unit **112**, the control circuitry **115** determines the position of the cords **102***a* at the time of receiving the signals and determines the time for which it receives a certain signal.

[0266] In case the control circuitry **105** determines that the position at the time of receiving the signals from the operation unit **112** corresponds to the unwound end position B, the control unit knows that a new unwound end position is being programmed. Thus, when the programming key **120** is disconnected, the control circuitry stores the position of the cords **102***a* or the electric motor **106** at the time of disconnection as the new unwound end position B.

[0267] In case the control circuitry **105** determines that the position at the time of receiving the signals from the operation unit **112** corresponds to a position between the wound up end position A and the unwound end position B and the signals are received for a defined time, preferably one second, the control unit knows that an intermediate position is being programmed. Thus, when the programming key **120** is disconnected, the control circuitry stores the position of the cords **102***a* or the electric motor **106** at the time of disconnection as an intermediate position.

[0268] In case the control circuitry **105** determines that the position at the time of receiving the signals from the operation unit **112** corresponds to the wound up end position A and the signals are received for a defined time, preferably one second, the control unit knows that an intermediate position is being deleted. Thus, when the programming key **120** is disconnected, the control circuitry deletes the intermediate position stored in the storage associated with the control circuitry **105**.

Claims

1. An architectural covering system comprising: a blind; an electric motor configured to wind the blind; and a controller coupled with the electric motor and configured to control operations of the electric motor to at least: increase a rotation speed of the electric motor over a first time period to a first rotation speed; responsive to the first rotation speed being reached and after the first time period, rotate the electric motor at the first rotation speed for a second time period; and after the second time period, increase the rotation speed of the electric motor over a third time period to a second rotation speed.

2. The architectural covering system of claim 1, wherein the controller is further configured to control operations of the electric motor to: rotate the electric motor at the first rotation speed during a time period between the first time period and the second time period.

3. The architectural covering system of claim 1, wherein the controller is further configured to control operations of the electric motor to: decrease the rotation speed of the electric motor over a fourth time period, after the second time period, to a third rotation speed.

4. The architectural covering system of claim 3, wherein at an end of the fourth time period, the electric motor is stopped.

5. The architectural covering system of claim 1, wherein the controller is further configured to: determine a current position of the blind before increasing the rotation speed of the electric motor over the first time period to the first rotation speed.

6. The architectural covering system of claim 1, wherein at least one of the first rotation speed or the second rotation speed are determined according to a speed profile.

7. The architectural covering system of claim 1, wherein increasing the rotation speed comprises increasing a voltage supplied to the electric motor.

8. The architectural covering system of claim 7, wherein increasing the voltage supplied to the electric motor comprises increasing a duty cycle.

9. The architectural covering system of claim 7, wherein increasing the voltage supplied to the electric motor comprises increasing an on-time of a signal transmitted to a power interface.

10. The architectural covering system of claim 7, wherein the second rotation speed is

programmable.

11. A method for controlling an architectural covering, the method comprising: increasing a rotation speed of an electric motor configured to wind the architectural covering over a first time period to a first rotation speed; responsive to the first rotation speed being reached and after the first time period, rotating the electric motor at the first rotation speed for a second time period; and after the second time period, increasing the rotation speed of the electric motor over a third time period to a second rotation speed.

12. The method of claim 11, further comprising: rotating the electric motor at the first rotation speed during a time period between the first time period and the second time period.

13. The method of claim 11, further comprising: decreasing the rotation speed of the electric motor over a fourth time period, after the second time period, to a third rotation speed.

14. The method of claim 11, wherein increasing the rotation speed comprises increasing a voltage supplied to the electric motor until the electric motor starts rotating.

15. The method of claim 11, wherein increasing the rotation speed comprises increasing a voltage supplied to the electric motor until the electric motor starts rotating.

16. A controller of an architectural covering, the controller comprising: one or more processors; and one or more memories storing instructions that, upon execution by the one or more processors, configure the controller to control operations of an electric motor of the architectural covering to at least: increase a rotation speed of the electric motor over a first time period to a first rotation speed; responsive to the first rotation speed being reached and after the first time period, rotate the electric motor at the first rotation speed for a second time period; and after the second time period, increase the rotation speed of the electric motor over a third time period to a second rotation speed.

17. The controller of the architectural covering of claim 16, wherein the instructions further configure the controller to: determine a current position of the architectural covering before increasing the rotation speed of the electric motor over the first time period to the first rotation speed.

18. The controller of the architectural covering of claim 16, wherein at least one of the first rotation speed or the second rotation speed are determined according to a speed profile.

19. The controller of the architectural covering of claim 16, wherein increasing the rotation speed comprises increasing a voltage supplied to the electric motor.

20. The controller of the architectural covering of claim 16, wherein the instructions further configure the controller to: determine the rotation speed of the electric motor.