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(54) **A TUBULAR MOTOR DRIVE FOR A SCREENING DEVICE SCREENING AND A METHOD FOR PRODUCING A TUBULAR MOTOR DRIVE FOR A SCREENING DEVICE**

(57) The invention relates to a tubular motor drive (1) for a screening device. The tubular motor drive comprises an electrical motor (2), an interchangeable gear set (24) having at least two stages, a further gear set (5) comprising a planetary gear set (6) arranged to be driven by

the interchangeable gear set, a coupling means (7) arranged to be rotated by the further gear set (5) and arranged to drive the screening device. The interchangeable gear set (24) is driveably arranged between the electrical motor (2) and the further gear set (5).

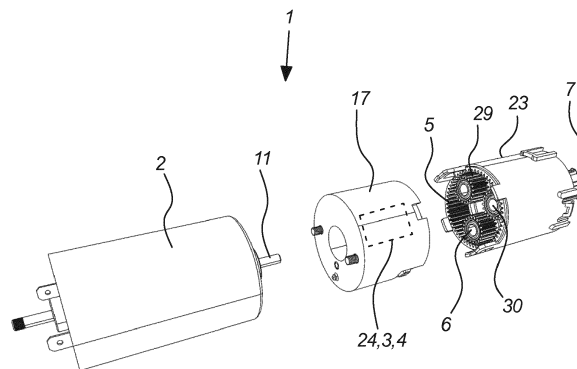


Fig. 1

Description

Background of the invention

[0001] The present invention relates to tubular motor drives for screening devices and to screening devices comprising such tubular motor drives. Particularly, the invention relates to gear sets of tubular motor drives.

Description of the Related Art

[0002] Motorized screening devices for windows are known in the art. Motors for driving such screening devices may be integrated with the screening devices in order to provide a suitable design. The rotation speed and torque provided by such motors may be adapted for use with screening devices by use of gear modules.

[0003] Different types of screening devices may require different rotation speeds and driving torques as provided by the motor. The different rotation speeds and driving torques may be achieved by use of specific gear modules for specific types of screening devices. However, it may be disadvantageous to require availability of many different gear modules in the production, e.g. in view of production costs. Accordingly, in order to simplify the production of different screening devices there is a need to reduce the number of different gear modules, or components thereof, required to be available for producing different screening devices.

[0004] EP 2 369 125 A2 discloses a motor drive for screening devices. The motor drive utilizes two replaceable planetary gears for reducing the motor speed. The motor drive is configurable to achieve different gear ratios without modifying the length of the motor drive by using a planetary gear or a coupling body for one of the gear stages, where the coupling body does not change the rotation speed. The use of such as coupling body for achieving different gear ratios may be disadvantageous for several purposes, e.g. in view of the required number of different gear components required for achieving different gear ratios of the motor drive.

[0005] Therefore, it is an object of the invention to provide an alternative motor drive for screening devices.

The invention

[0006] An aspect of the invention relates to a tubular motor drive for a screening device, where the tubular motor drive comprises:

an electrical motor,
a first interchangeable gear set having a first gear ratio and having at least two stages, where the first interchangeable gear set is interchangeable by a second interchangeable gear set having a second gear ratio and having at least two stages, and where the first gear ratio and the second gear ratio are different,

a further gear set comprising a planetary gear set arranged to be driven by the first interchangeable gear set, alternatively the second interchangeable gear set,

a coupling means arranged to be rotated by the further gear set and arranged to drive the screening device,

where the first interchangeable gear set, alternatively the second interchangeable gear set, is driveably arranged between the electrical motor and the further gear set.

[0007] Advantageously, the use of a two-stage gear set may provide a tubular motor drive which has a simpler and cheaper construction compared to other tubular motor drives with other types of gear sets, e.g. tubular motor drives comprising only planetary gear sets.

[0008] Furthermore, the use of a two-stage gear set may facilitate design of silent motor drives since the two-stage gear set may include one or more helical gears. For example, the driven input gear of the two stage gear may be a helical gear arranged to mesh with a helical driving gear, e.g. a helical motor gear connected to an output shaft of the electrical motor.

[0009] Furthermore, the assembly of the tubular motor drive by use of a two-stage gear as the interchangeable gear set may simplify the production due to the relatively few gear components of the two-stage gear as compared to other types of gear sets.

[0010] The use of two-stage gear sets for the interchangeable gear set may be advantageous since two or more two-stage gear sets having different gear ratios but the same gear-interfaces may be made available for use with the tubular motor drive.

[0011] The first and second interchangeable gear sets may be configured to reduce the rotation speed of the electrical motor and the further gear set may be configured to further reduce the rotation speed so that the coupling means provides a low speed and high torque output. Since the input gear of the two stage gear meshes with the high-speed driving gear, e.g. motor gear, the use of helical gears for the input and driving gears may be efficient for reducing gear noise.

[0012] Advantageously, the first interchangeable gear set, alternatively the second interchangeable gear set, is driveably arranged between the electrical motor and the further gear set. Accordingly, the interchangeable gear set is driven directly by the motor and the further gear set is driven directly by the interchangeable gear set.

[0013] Advantageously, since the first interchangeable gear set is configured to be replaced by the second interchangeable gear set, the gear ratio of the tubular motor drive may advantageously be changed without requiring other changes, e.g. changes to the further gear set.

[0014] It should be noted that the term "*coupling means*" in this context should be interpreted as any kind of coupling or connector suited for connecting with other parts of the screening device, i.e. any snap connector,

threaded connector, conical connector, connector to be connected by means for screws or pins, or other or any combination thereof.

[0015] In an aspect of the invention the first interchangeable gear set and the second interchangeable gear set comprises a same input gear component arranged to be driven by the electrical motor and a same output gear component arranged to drive the planetary gear set.

[0016] Advantageously, use of interchangeable gear sets having the same gear interfaces may be advantageous for the production of tubular motor gears since other parts of the tubular motor gears may have the same interfaces and be used with different interchangeable gear sets.

[0017] In an aspect of the invention the first interchangeable gear set and the second interchangeable gear set comprises an off-axis gear set and an axial gear set arranged to be driven by the off-axis gear set, where the off-axis gear set is radially displaced relative to an output shaft of the electrical motor and where the axial gear set is co-axial with an output shaft of the electrical motor.

[0018] Advantageously, the use of an off-axis gear set radially displaced relative to the motor shaft may be advantageous for obtaining a compact gear set since the off-axis gear set may be arranged to mesh with an axial motor gear. The axial gear set may advantageously provide an axial output gear which may connect axially with a further gear set.

[0019] In an aspect of the invention the off-axis gear set comprises a first input gear and a first output gear, where the first input gear is arranged to mesh with a motor gear and where the first output gear is arranged to mesh with a gear component of the axial gear set, the first input gear being co-axial with the first output gear.

[0020] The off-axis gear configured with a first input gear and a first co-axial output gear may be advantageous for obtaining a gear set where the input gear and the output gear have different numbers of teeth and/or different diameters.

[0021] In an aspect of the invention the first input gear of the off-axis gear set is a helical gear.

[0022] The use of a helical gear for the input gear may be advantageous for lowering the gear noise since the input gear may have a higher rotation speed than other gears of the tubular motor drive.

[0023] In an aspect the tubular motor drive comprises the motor gear which is connected with the output shaft of the electrical motor and arranged to mesh with the first input gear of the off-axis gear set.

[0024] Advantageously, the motor gear may be connected to the output shaft of the electrical motor in order to provide a rigid and reliable connection between the motor gear and motor shaft.

[0025] In an aspect of the invention the axial gear set comprises a second input gear and a second output gear, where the second input gear is arranged to mesh with

the first output gear of the off-axis gear set and where the second output gear is arranged to mesh with a gear component of the further gear set, the second input gear being co-axial with the second output gear.

[0026] The axial gear configured with a second input gear and a second co-axial output gear may be advantageous for obtaining a gear set where the input gear and the output gear have different numbers of teeth and/or different diameters and/or are where one of the gears is an inner gear and where the other is an outer gear.

[0027] In an aspect of the invention the second input gear of the axial gear set of the first interchangeable gear set is an outer gear. In a related aspect of the invention the second input gear of the axial gear set of the second interchangeable gear set is an inner gear. Advantageously, use of an outer gear for the first interchangeable gear set and an inner gear, i.e. a ring gear, for the second interchangeable gear set may be advantageous for obtaining different gear ratios of the interchangeable gear sets.

[0028] Furthermore, by use of an outer gear and an inner gear, different gear ratios may be obtained when only one of the gears of the interchangeable gears sets is different from the other.

[0029] In an aspect of the invention, the tubular motor drive comprises a first tubular housing configured to accommodate the first interchangeable gear set, alternatively the second interchangeable gear set.

[0030] Advantageously, the same tubular housing may be configured to be used both for the first and the second interchangeable gear set.

[0031] An aspect of the invention relates to a screening device for screening an architectural opening, such as a window, the screening device comprises:

a tubular motor drive according to any of the previous aspects,
screening means for screening at least a part of said architectural opening,
where the tubular motor drive is arranged to displace the screening means.

[0032] The tubular motor drive may be particularly advantageous for use with screening devices, since the tubular motor drive may be used for different screening devices requiring different rotation speeds and torques for displacing the screening means.

[0033] It should be noted that the term "*Screening means*" in this context should be interpreted as any kind of screen suited for screening a window, i.e. any kind of curtain, drape, blind, shade, shutter or other or any combination thereof.

[0034] An architectural opening in this context should be interpreted as any kind of window, door, hole and other architectural opening provided in buildings and other structures. For convenience, examples, embodiments and other descriptions are mainly described with reference to windows, but are not limited to use with windows

unless otherwise noted.

[0035] In an aspect of the invention, the screening device comprises a reel means arranged to be rotated around a longitudinal rotational axis by means of the tubular motor drive, wherein a first end of the screening means is connected to the reel means so that the screening means can be rolled off or rolled up around said reel means dependent on a rotational direction of said reel means.

[0036] It should be noted that the term "*reel means*" in this context should be interpreted as any kind of roller, tube, cylinder, or other reel means arranged to be rotated around a longitudinal rotational axis or other or any combination thereof.

[0037] The tubular motor drive may advantageously be used for a reel means arranged to be rotated around a longitudinal rotational axis by means of the tubular motor drive. Accordingly, the screening device may be configured so that tubular motor drive may be circumscribed by the reel means, i.e. so that the tubular motor drive is fully or partially contained within the reel means. Such screening devices include roller shutters, retractable awnings, roller blinds, etc.

[0038] An aspect of the invention relates to a method for producing a tubular motor drive for a screening device, the method comprises providing an electrical motor, selecting a first interchangeable gear set having a first gear ratio or a second interchangeable gear set having a second gear ratio, where the first and second interchangeable gear sets each has at least two stages, and where the first gear ratio and the second gear ratio are different, connecting the first interchangeable gear set, alternatively the second interchangeable gear set to the electrical motor, where the first and second interchangeable gear sets are driveable by the electrical motor, and connecting a further gear set to the first or second interchangeable gear set, where the further gear set comprises a planetary gear set arranged to be driven by the first interchangeable gear set, alternatively the second interchangeable gear set, and where the further gear set is arranged to drive a coupling means arranged for driving the screening device.

[0039] Advantageously, the tubular motor drive may be produced by connecting firstly an interchangeable gear set to the motor and secondly by connecting the further gear set to the interchangeable gear set. By having a choice between at least two different interchangeable gear sets, the tubular motor drive may be configured according to a desired gear ratio.

[0040] In an aspect of the invention, the step of connecting the first interchangeable gear set, alternatively connecting a second interchangeable gear set to the electrical motor, comprises:

connecting a first tubular housing to the electrical motor,

connecting an off-axis gear set to a first axle of the first tubular housing so that it meshes with a motor gear arranged to be driven by the electrical motor, and

connecting an axial gear set to a second axle of the first tubular housing so that a gear component of the axial gear set meshes with another gear component of the off-axis gear set.

[0041] The step-wise assembly of the interchangeable gear set may provide a simple production method for the tubular motor drive which allows setting the gear ratio of the tubular motor drive by selecting between different gear components, e.g. by selecting between different axial gear sets. Thus, according to the step-wise assembly method, the tubular motor drive may easily be configured with a desired gear ratio by connecting a particular axial gear set to the first tubular housing.

20 Figures

[0042] The invention will be described in the following with reference to the figures in which

- 25 fig. 1 shows a tubular motor drive for a screening device,
- fig. 2 shows an embodiment of the tubular motor drive gear configured with components of a first interchangeable gear set,
- 30 fig. 3 shows an embodiment of the tubular motor drive gear configured with components of a second interchangeable gear set,
- fig. 4 illustrates a method for producing the tubular motor drive,
- 35 fig. 5 shows an example of a screening device, and
- fig. 6 shows another example of a screening device.

Detailed description of the invention

[0043] Fig. 1 shows a tubular motor drive 1 for a screening device, such as the screening device 8 shown in Fig. 6.

[0044] The tubular motor drive 1 comprises an electrical motor 2, e.g. an electrical AC or DC motor and an interchangeable gear set 24 which could be a first interchangeable gear set 3 or a second interchangeable gear set 4 (not illustrated in Fig. 1, but illustrated in Fig. 2 and Fig. 3). The interchangeable gear set 24 is schematically illustrated behind the enclosure of a first tubular housing 17. The first and second interchangeable gear sets 3, 4 are detachably arranged to be driven by the electrical motor 2 as exemplified below. The first tubular housing 17 and, thereby, the first and second interchangeable gear sets 3, 4 may be detachably connected to the motor 2 via a screw connection, as illustrated or by other connection types.

[0045] The first interchangeable gear set 3 is interchangeable by a second interchangeable gear set 4. I.e.

the first and second interchangeable gear sets 3, 4 and the tubular motor drive 1 are configured so that the first and second interchangeable gear sets 3, 4 are capable of being used in place of each other. Accordingly, the same first tubular housing 17 may be configured to accommodate the first interchangeable gear set 3 or the second interchangeable gear set 4.

[0046] The first interchangeable gear set 3 has a first gear ratio and the second interchangeable gear set 4 as a second gear ratio. The first and second ratios are different. In one example, the ratio difference results in output difference of 100-500%. Hereby the motor drive is suitable for different types of screenings as roller shutters or awnings.

[0047] The first and second interchangeable gear sets may be of the same type or different types. In an embodiment the first and second interchangeable gear sets 3, 4 are both of a type having at least two stages.

[0048] In this context a two stage gear set is defined as a gear set which perform a change in rotation speed or torque, and/or transmission of a torque without changing the torque, twice at respective two different gear mesh locations. In other words, the two stage gear set comprises a first stage in the form of an input gear for performing a first change or transmission of a rotation speed or torque received via a gear mesh with a driving gear, e.g. a motor gear. The driving gear and input gear may have a different number of teeth or the same number or teeth. The two stage gear set further comprises a second stage for performing a second change or transmission of a rotation speed or torque received via a gear mesh with another driving gear, e.g. an intermediate gear component of the two stage gear set. Whether the driving gear is a motor gear fixedly connected to an output shaft of the electrical motor 2, or the driving gear is comprised by the first or second interchangeable gear set, e.g. as a motor gear arranged to be connected with an output shaft of the electrical motor 2, the first and second interchangeable gear sets 3, 4 may in this context be defined as a gear set having at least two gear stages.

[0049] Additionally or alternatively, the two stage gear set may be defined as a gear set which comprises a number of serially connected gears, i.e. a number of single gears which transmit a received torque received via a gear mesh to other single gears. I.e. in a series connection, the torque is transmitted between meshing gears via one-to-one gear meshes.

[0050] Furthermore, the two stage gear set may alternatively or additionally be defined as a gear set which comprises at least one pair of gears, where the gears of the pair of gears are arranged co-axially and co-rotating, i.e. arranged to rotate about the same axis and arranged to rotate with the same rotation speed.

[0051] The tubular motor drive 1 further comprises a further gear set 5 contained within a second tubular housing 23. The further gear set 5 may comprise a planetary gear set 6, or possibly another gear set type, arranged to be driven by the first interchangeable gear set 3, al-

ternatively the second interchangeable gear set 4. The further gear set 5 may comprise one or more additional gear sets, e.g. planetary gear sets.

[0052] The tubular motor drive 1 further comprises a coupling means 7 arranged to be driven, e.g. rotated, by the further gear set 5, e.g. via a rotatable connection to the planetary gear set 6, or arranged to driven by other gear sets comprised by the further gear set. The coupling means 7 is arranged to drive the screening device 8 as exemplified below.

[0053] One of the first and second interchangeable gear sets 3, 4 are driveably arranged between the electrical motor 2 and the further gear set 5. Accordingly, the first or second interchangeable gear set 3, 4 constitute the first gear set driven by the motor. Accordingly, the first or second interchangeable gear set 3, 4 constitute the gear set which receives the highest rotation speed, i.e. the rotation speed of the electrical motor 2. Due to the high rotation speed, the first or second interchangeable gear set 3,4 may advantageously by configured as a two-stage gear set due to the relatively low torque values transmitted through this first gear set.

[0054] Furthermore, the use of a two-stage gear set may be advantageous for the purpose of providing a low noise gear set since one or more gears of the two-stage train may be configured as helical gears.

[0055] The first and second interchangeable gear sets 3, 4 are interchangeable by means of the configuration of the tubular motor drive 1 and by means of the configuration of the first and second interchangeable gear sets 3, 4. For example, the first and second interchangeable gear sets 3, 4 may be configured to have the same drivable interfaces to engage with a driving interface of the motor 2 and the same driving interfaces to engage with a drivable interface of the further gear set 5.

[0056] For example, the first interchangeable gear set 3 and the second interchangeable gear set 4 may be configured with a same input gear component arranged to be driven by the electrical motor 2, e.g. via a driving gear or a motor gear, and with a same output gear component arranged to drive the planetary gear set 6. Furthermore, the first interchangeable gear set 3 and the second interchangeable gear set 4 may both have similar structural dimensions, e.g. the same distance between the input gear and the output gear, so that the total length of the tubular motor drive is independent of which of the first and second interchangeable gear sets 3, 4 are used for the tubular motor drive. Furthermore, the tubular motor drive 1, e.g. the motor 2 and the further gear set 5 may be configured to enable connection and detachment of one of the first and second interchangeable gear sets 3, 4, e.g. by means of screw connection, snap-connections, press-fitting connection or other connection means. Accordingly, the first tubular housing 17 may be configured to be detachably connectable with the electrical motor 2.

[0057] According to an embodiment, the first interchangeable gear set 3 and the second interchangeable

gear set 4 may comprise the same off-axis gear set 9. Use of identical off-axis gear sets for both of the interchangeable gears set 3, 4 may advantageously reduce costs of the tubular motor drive 1.

[0058] The tubular motor drive 1 may have a tubular, e.g. a cylindrical outer shape. In this context, by a cylindrical outer shape is meant a shape having constant radius between the longitudinal axis of the shape and the outer cylindrical shape axially along the longitudinal axis and angularly along the cylindrical circumference.

[0059] Fig. 2 shows an embodiment of the tubular motor drive 1 showing the gear components of the first interchangeable gear set 3 where the first tubular housing 17 has been removed.

[0060] Fig. 3 shows an embodiment of the tubular motor drive 1 corresponding to the embodiment shown in Fig. 2, but where Fig. 3 shows the gear components of the second interchangeable gear set 4.

[0061] Fig. 2 and Fig. 3 show that the first and second interchangeable gear sets 3, 4 comprise an off-axis gear set 9 and an axial gear set 10 arranged to be driven by the off-axis gear set 9. The off-axis gear set 9 is radially displaced relative to an output shaft 11 of the electrical motor 2. In this way a first input gear 12 of the off-axis gear set 9 is capable of meshing with the axially arranged motor gear 14 attached to the shaft 11. The axial gear set 10 is co-axial with the output shaft 11 of the electrical motor 2.

[0062] According to an embodiment, the electrical motor 2, the first or second interchangeable gear set 3, 4, the further gear set 6 and the coupling means 7 may be co-axially arranged in the sense that the motor shaft 11, a centre axis of the first and second interchangeable gear sets 3, 4, e.g. the rotation axis of the axial gear set 10, and the centre axes of the further gear set 5 and the planetary gear set 6 and the rotation axis of the coupling means 7 are co-axially arranged, i.e. they share a common axis. Accordingly, with reference to the embodiments of Fig. 2 and Fig. 3, the rotation axis of the off-axis gear set 9 is radially displaced relative to this common axis.

[0063] The off-axis gear set 9 comprises a first input gear 12 and a first output gear 13, where as noted, the first input gear 12 is arranged to mesh with the motor gear 14. The first output gear 13 is arranged to mesh with a gear component of the axial gear set 10. The first input gear 12 may be co-axial with the first output gear 13. Furthermore, the first input gear 12 may be co-rotatable with the first output gear 13, i.e. the gears rotate with the same rotation speed. As an example, the off-axis gear set 9 may be obtained by attaching the first input gear 12 and the first output gear 13 to a common first axle 21.

[0064] According to an embodiment, the first input gear 12 of the off-axis gear set 9 is a helical gear. The motor gear 14 may be connected, fixedly or detachable, with the output shaft 11 of the electrical motor 2 and may be arranged to mesh with the first input gear 12 of the off-axis gear set 9. Accordingly, the motor gear may be a

helical gear in order to mesh with a helical input gear 12. Alternatively, the first input gear 12 and the motor gear 14 are linearly toothed gears. The first output gear 13 of the off-axis gear set 9 may be a linearly toothed gear or a helical gear. A linearly toothed gear for the first output gear 13 may be preferred in order to simplify the design of the first and second interchangeable gear sets 3, 4.

[0065] The axial gear set 10 comprises a second input gear 15 and a second output gear 16. The second input gear 15 may be arranged to mesh with the first output gear 13 of the off-axis gear set 9 and the second output gear 16 may be arranged to mesh with a gear component of the further gear set 5, e.g. planet gears of the planetary gear set 6. The second input gear 15 may be co-axial with the second output gear 16 and the second input gear 15 may be co-rotatable with the second output gear 16. As an example, the axial set 10 may be obtained by attaching the second input gear 15 and the second output gear 16 to a common second axle 22. The axes of the off-axis gear set 9 and the axial gear set 10, may be supported by the first tubular housing 17. The input gear 15 and the output gear 16 of the axial gear set 10 may be linearly toothed gears, but one or both of the input gear 15 and the output gear 16 could alternatively be helical gears.

[0066] According to an embodiment, the second input gear 15 of the axial gear set 10 of the first interchangeable gear set 3 is an outer gear as illustrated in Fig. 2 and according to this or other embodiments, the second input gear 15 of the axial gear set 10 of the second interchangeable gear set 4 is an inner gear as illustrated in Fig. 3. The axial gear set 10 for the first interchangeable gear set 3 and the axial gear set 10 for the second interchangeable gear set 4 may be configured so that both of them comprises the same second output gear 16.

[0067] As illustrated in Figs. 2-3, the axial gear set 10 for the first and second interchangeable gear sets 3, 4 may comprise a shielding plate 25. The shielding plate 25 has a circular shape and a diameter which is smaller than the diameter of the circular end-opening of the first tubular housing 17, i.e. small enough to allow the shielding plate to be circumscribed by the cylindrical wall of the first tubular housing 17. The shielding plate may be fixedly arranged relative to the second input gear 15 and the second output gear 16. Accordingly, the shielding plate 25 may be co-rotatable and co-axially arranged (relative to the circular centre of the shielding plate) with the second input gear 15 and the second output gear 16. When assembled, the shielding plate 25 at least partially closes the circular opening of the first tubular housing 17. The shielding plate 25 may constitute a circular disc located between the second input gear 15 and the second output gear 16 of the axial gear set 10 for the first interchangeable gear set 3. For the second interchangeable gear set 4, the shielding plate 25 may be constituted by a disc extending inwardly from the circumference of the inner gear 15 (ring gear) towards the axial centre of the inner gear 15. Accordingly, the second input gear 15,

being an inner gear, may be configured as a cylinder having an open end and an opposite closed end, where the closed end constitutes the shielding plate 25 and where the teeth of the input gear 15 are formed along the inner circumference of the cylinder wall. It is noted that the shielding plate 25 is optional.

[0068] Figs. 1-3 show that the tubular motor drive 1 comprises a second tubular housing 23 accommodating the planetary gear set 6. The second tubular housing 23 may be configured to be detachably connected with the first tubular housing 17.

[0069] Fig. 1 shows that the planetary gear set 6 may comprise a ring gear 29 and planetary gears 30, where the planetary gears 30 are arranged to couple the first interchangeable gear set 3, alternatively the second interchangeable gear set 4, by means of the second output gear 16, to the ring gear 29. Accordingly, in this configuration the second output gear 16 has the function of a sun gear for the planetary gear set 6. The planetary gears 30 may be rotatably supported by a planetary gear carrier (not shown) and the planetary gear carrier may be connected with the coupling means 7 for rotating the coupling means 7.

[0070] Fig. 4 illustrates a part of the tubular motor drive 1 and a method for producing the tubular motor drive. The tubular motor drive 1 may be produced by first providing the electrical motor 2. According to the desired gear ratio of the tubular motor drive 1, either a first interchangeable gear set 3 or a second interchangeable gear set 4 is selected. The selected interchangeable gear set is connected to the electrical motor 2 so that connected interchangeable gear set can be driven by the electrical motor 2. Additionally, not shown, the further gear set 5 and the coupling means 7 is connected to the already connected interchangeable gear set.

[0071] As illustrated, the step of connecting one of the interchangeable gear sets to the motor 2, may be achieved by connecting the first tubular housing 17 to the electrical motor 2. After that, the off-axis gear set 9 is attached, e.g. by connecting the off-axis gear set 9, or the gear components 12, 13 of the off-axis gear set, to a first axle 21 of the first tubular housing 17 so that it meshes with the motor gear 14. Then the axial gear set 10 is attached, e.g. by connecting the axial gear set 10, or the gear components 15, 16 of the axial gear set, to a second axle 22 of the first tubular housing 17 so that a gear component of the axial gear set 10 meshes with a gear component of the off-axis gear set 9. The axial gear set 10 to be attached may be selected according to the desired gear ratio of the tubular motor drive 1.

[0072] According to an example, the interchangeable gear set 3, 4 could have a gear ratio of 4.8. The further gear set 5 could be constituted by two planet gears 6 each having a gear ratio of 4.8 so that the resulting gear ratio of the tubular motor module 1 becomes approx. 111. By selecting a different interchangeable gear set 3, 4 having a gear ratio of 9, a resulting gear ratio of approx. 207 is obtained. The first interchangeable gear set (3,10)

and the second interchangeable gear set (4,10) may each be unitary bodies so the two interchangeable gear sets may each be moulded as one body only. This is advantageous so the output ratio of the tubular motor drive may be selected by changing one component.

[0073] Fig. 5 shows an example of a screening device 8 for screening an architectural opening, such as a window. The screening device 8 comprises the tubular motor drive 1 being arranged to displace a screening means (not shown). The screening device 8 comprises a motor tube 26. The motor tube 26 is shown removed from the rest of the screening device 8. When assembled, the interior of the motor tube 26 contains the rest of the screening device 8.

[0074] The screening device 8 further comprises a reel connector 19 arranged to connect with the coupling means 7 and, therefore, arranged to be rotated by the coupling means 7. The reel connector 19 is arranged to connect with and to rotate a screening roller, tube, cylinder, or other reel means (not shown) arranged to be rotated around a longitudinal rotational axis by means of the tubular motor drive 1. A first end 20 of the screening means 18 is connected to this reel means so that the screening means 18 can be rolled off or rolled up around the reel means dependent on a rotational direction of the reel means. In this example, the reel means circumscribes the motor tube 26 and extends from the reel connector 19 along the length of the motor tube 26. Accordingly, the screening device 8 may be, or form part of, e.g. a roller shutter, an awning, a retractable awning, a roller blind or other screening device.

[0075] According to this example, the screening device 8 comprises the motor 2, the first or second interchangeable gear set 3, 4, the further gear set 5, and a power module 33. The tubular motor drive 1 and the power module 33 are arranged to substantially extend the entire length of the motor tube 26. According to this example, the far end of the motor tube 26 is formed to engage with an engagement portion of the tubular motor drive 1 and the closest end is arranged to engage with e.g. a bracket 34 intended connection with a window part. Thereby, the motor tube 26, the tubular motor drive 1, the power module 33 and the bracket 34 are all stationary while the reel connector 19 is free to rotate and, thereby, to displace a screening means, e.g. via a screening means rolled up on screening roller, where the screening roller is arranged to be rotatably driven by the coupling means 7. According to this example, the tubular motor drive 1 is arranged to displace the screening means 18 by rotating the screening means.

[0076] Fig. 6 shows another screening device 8 for screening an architectural opening. The screening device 8 comprises the tubular motor drive 1 being arranged to displace the screening means 18, e.g. a roller blind.

[0077] The screening device 8 comprises a first transversal profile 26 having a fixed position relative to the window (not shown) and a second transversal profile 27 which is moveably arranged relative to the first transver-

sal profile 26. The screening device 1 further comprises a screening means 18 extending between the first and second transversal profiles. A first end 20 of the screening means is connected to the first transversal profile, e.g. to a screening roller. In this example of a screening device 8, the tubular motor drive 1 is comprised by the second transversal profile 27 and the tubular motor drive 1 is arranged to move the second transversal profile 27, e.g. by means of gear wheels 31 arranged at opposite ends of the second transversal profile 27 to engage with corresponding racks 32 arranged at opposite horizontal sides in the window. According to this example, the tubular motor drive 1 is arranged to displace the screening means 18 by moving the second transversal profile 27.

List

[0078]

1. Tubular motor drive
2. Electrical motor
3. First interchangeable gear set
4. Second interchangeable gear set
5. Further gear set
6. Planetary gear set
7. Coupling means
8. Screening device
9. Off-axis gear set
10. Axial gear set
11. Output shaft of electrical motor
12. First input gear
13. First output gear
14. Motor gear
15. Second input gear
16. Second output gear
17. First tubular housing
19. Reel connector
18. Screening means
20. First end of screening means
21. First axle
22. Second axle
23. Second tubular housing
24. Interchangeable gear set
25. Shielding plate
26. Motor tube
26. First transversal profile
27. Second transversal profile
28. Guide means
29. Ring gear
30. Planetary gears
31. Toothed wheel
32. Rack
33. Power module
34. Bracket

Claims

1. A tubular motor drive (1) for a screening device (8), the tubular motor drive comprises
an electrical motor (2),
a first interchangeable gear set (3) having a first gear ratio and having at least two stages, where the first interchangeable gear set (3) is interchangeable by a second interchangeable gear set (4) having a second gear ratio and having at least two stages, and where the first gear ratio and the second gear ratio are different,
a further gear set (5) comprising a planetary gear set (6) arranged to be driven by the first interchangeable gear set, alternatively the second interchangeable gear set,
a coupling means (7) arranged to be rotated by the further gear set (5) and arranged to drive the screening device,
where the first interchangeable gear set (3), alternatively the second interchangeable gear set (4), is driveably arranged between the electrical motor (2) and the further gear set (5).
2. A tubular motor drive according to claim 1, where the first interchangeable gear set (3) and the second interchangeable gear set (4) comprises a same input gear component arranged to be driven by the electrical motor (2) and a same output gear component arranged to drive the planetary gear set (6).
3. A tubular motor drive according to any of the preceding claims, where the first interchangeable gear set (3) and the second interchangeable gear set (4) comprises an off-axis gear set (9) and an axial gear set (10) arranged to be driven by the off-axis gear set (9), where the off-axis gear set (9) is radially displaced relative to an output shaft (11) of the electrical motor (2) and where the axial gear set (10) is co-axial with an output shaft (11) of the electrical motor (2).
4. A tubular motor drive according to claim 3, where the off-axis gear set (9) comprises a first input gear (12) and a first output gear (13), where the first input gear (12) is arranged to mesh with a motor gear (14) and where the first output gear (13) is arranged to mesh with a gear component of the axial gear set (10), the first input gear (12) being co-axial with the first output gear (13).
5. A tubular motor drive according to claim 4, where the first input gear (12) of the off-axis gear set (9) is a helical gear.
6. A tubular motor drive according to any of claims 4-5, where the tubular motor drive (1) comprises the motor gear (14) connected with the output shaft (11) of

the electrical motor (2) and arranged to mesh with the first input gear (12) of the off-axis gear set (9).

7. A tubular motor drive according to any of claims 4-6, where the axial gear set (10) comprises a second input gear (15) and a second output gear (16), where the second input gear (15) is arranged to mesh with the first output gear (13) of the off-axis gear set (9) and where the second output gear (16) is arranged to mesh with a gear component of the further gear set (5), the second input gear (15) being co-axial with the second output gear (16). 5
8. A tubular motor drive according to claim 7, where the second input gear (15) of the axial gear set (10) of the first interchangeable gear set (3) is an outer gear. 10
9. A tubular motor drive according to claim 7, where the second input gear (15) of the axial gear set (10) of the second interchangeable gear set (4) is an inner gear. 15
10. A tubular motor drive according to any of the preceding claims, where the tubular motor drive (1) comprises a first tubular housing (17) configured to accommodate the first interchangeable gear set (3), alternatively the second interchangeable gear set (4). 20
11. A tubular motor drive according to any of the preceding claims, where the first interchangeable gear set (3,10) and the second interchangeable gear set (4,10) are both unitary bodies. 25
12. A screening device (8) for screening an architectural opening, such as a window, the screening device comprises a tubular motor drive (1) according to any of claims 1-10, screening means (18) for screening at least a part of said architectural opening, where the tubular motor drive (1) is arranged to displace the screening means (18). 30
13. A screening device according to claim 11, further comprising a reel means arranged to be rotated around an longitudinal rotational axis by means of the tubular motor drive (1), wherein a first end (20) of the screening means (18) is connected to the reel means so that the screening means (18) can be rolled off or rolled up around said reel means (19) dependent on a rotational direction of said reel means (19). 35
14. A method for producing a tubular motor drive for a screening device, the method comprises 40

- providing an electrical motor (2),
- selecting a first interchangeable gear set (3) having a first gear ratio or a second interchangeable gear set (4) having a second gear ratio, where the first and second interchangeable gear sets each has at least two stages, and where the first gear ratio and the second gear ratio are different,
- connecting the first interchangeable gear set (3), alternatively the second interchangeable gear set (4) to the electrical motor (2), where the first and second interchangeable gear sets are driveable by the electrical motor (2),
- connecting a further gear set (5) to the first or second interchangeable gear set, where the further gear set comprises a planetary gear set (6) arranged to be driven by the first interchangeable gear set (3), alternatively the second interchangeable gear set (4), and where the further gear set (5) is arranged to drive a coupling means (7) arranged for driving the screening device (1). 45

15. A method according to claim 14, where connecting the first interchangeable gear set (3), alternatively connecting a second interchangeable gear set (15), comprises connecting a first tubular housing (17) to the electrical motor (2), connecting an off-axis gear set (9) to a first axle (21) of the first tubular housing (17) so that it meshes with a motor gear (14) arranged to be driven by the electrical motor (2), and connecting an axial gear set (10) to a second axle (22) of the first tubular housing (17) so that a gear component of the axial gear set (10) meshes with another gear component of the off-axis gear set (9). 50

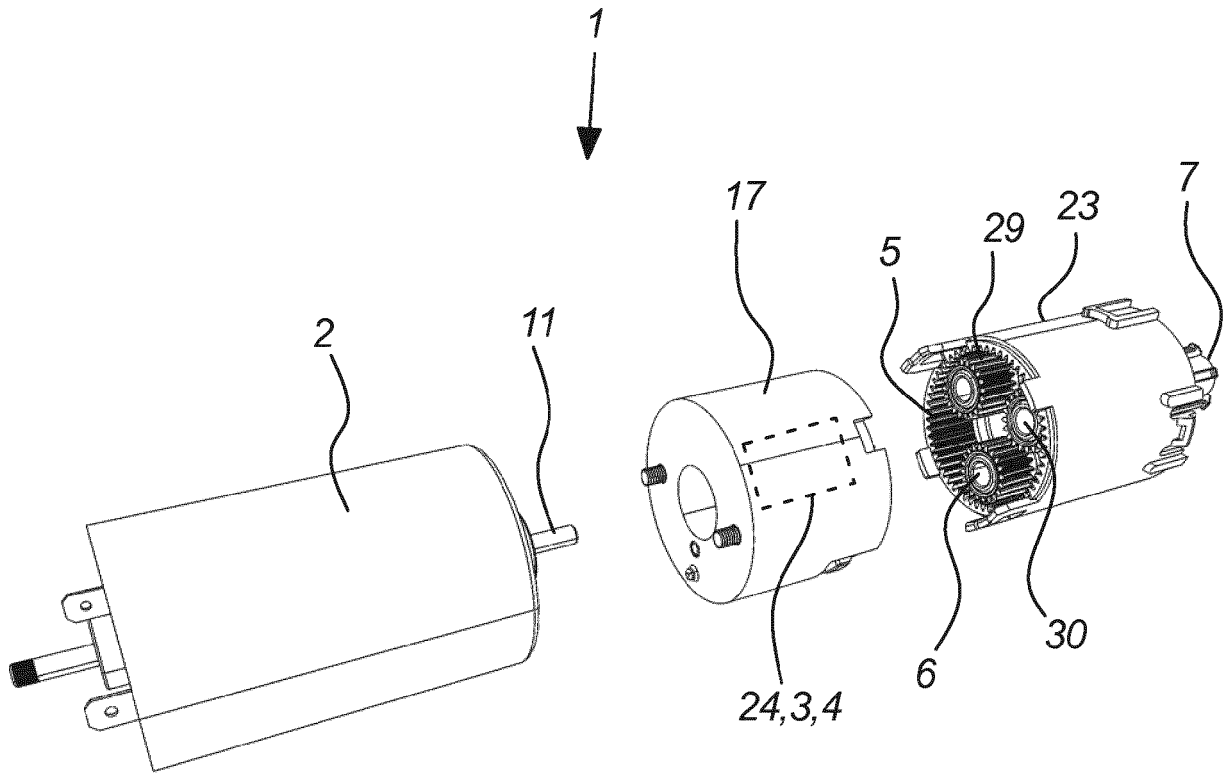


Fig. 1

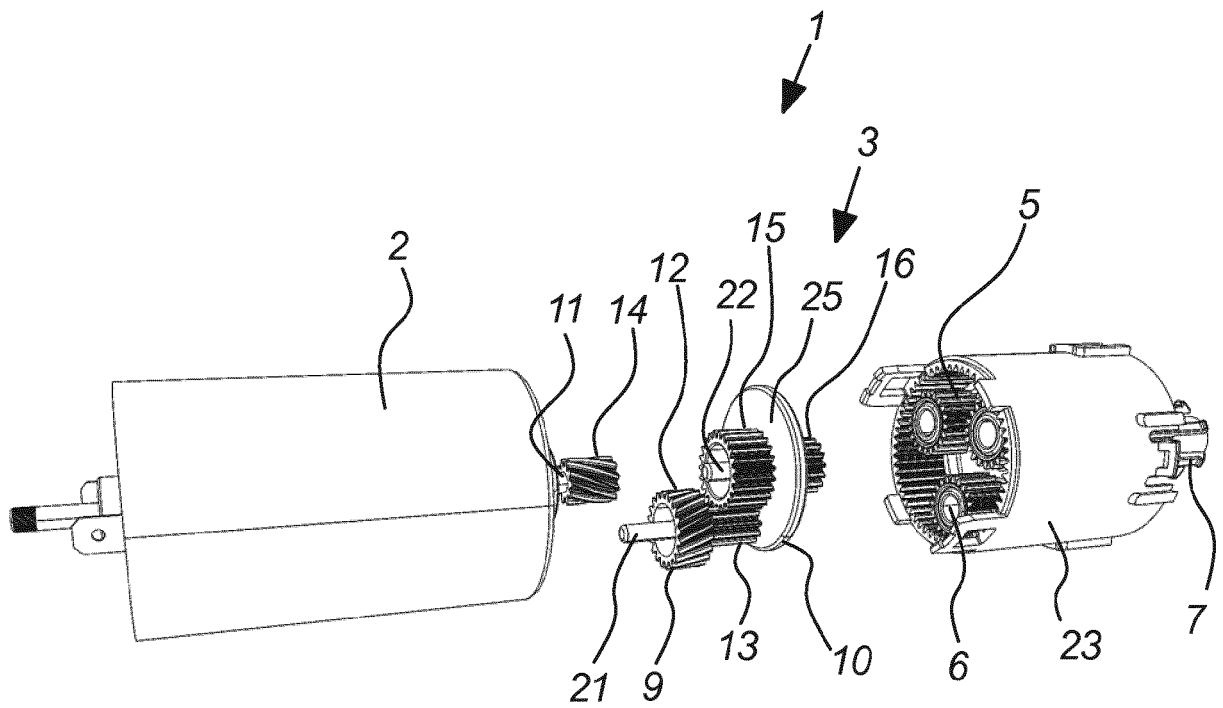


Fig. 2

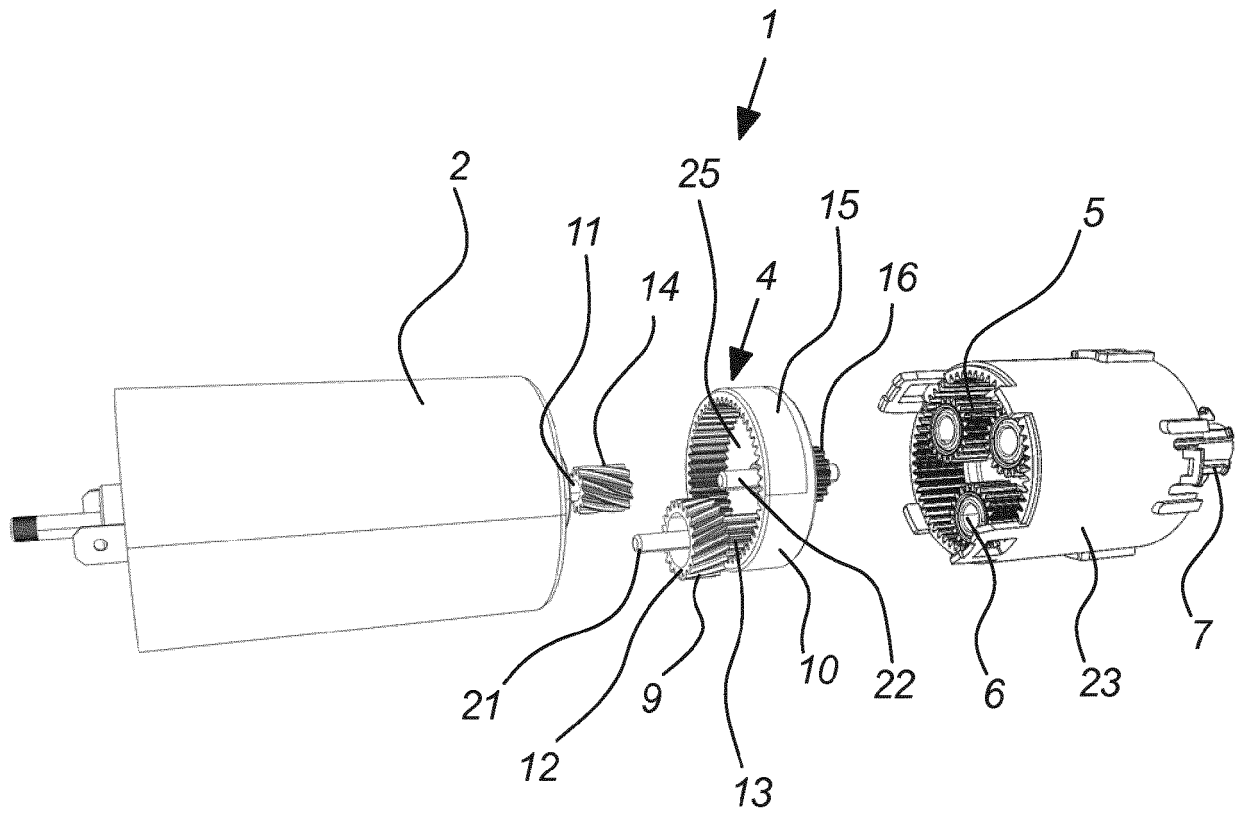


Fig. 3

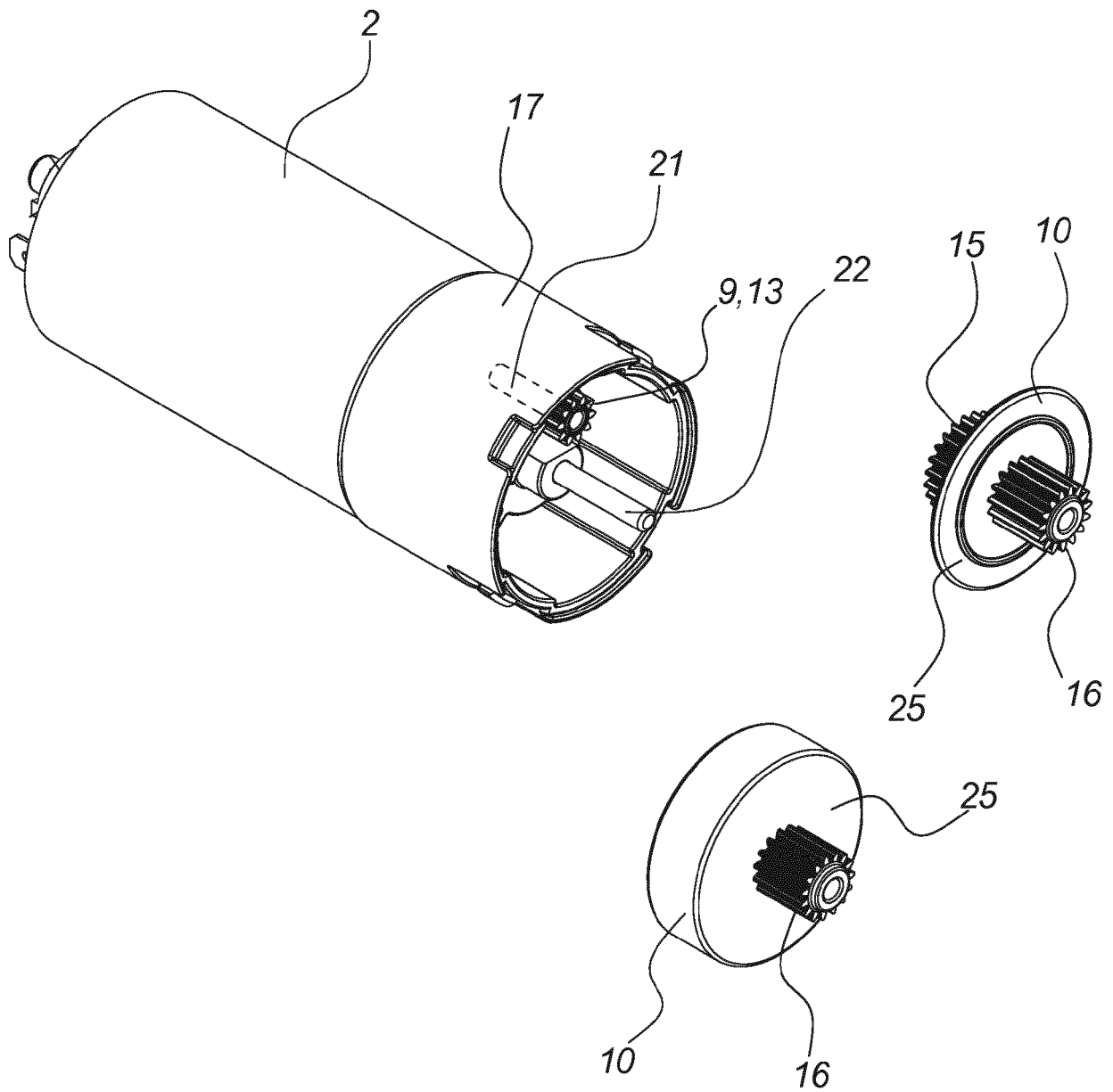


Fig. 4

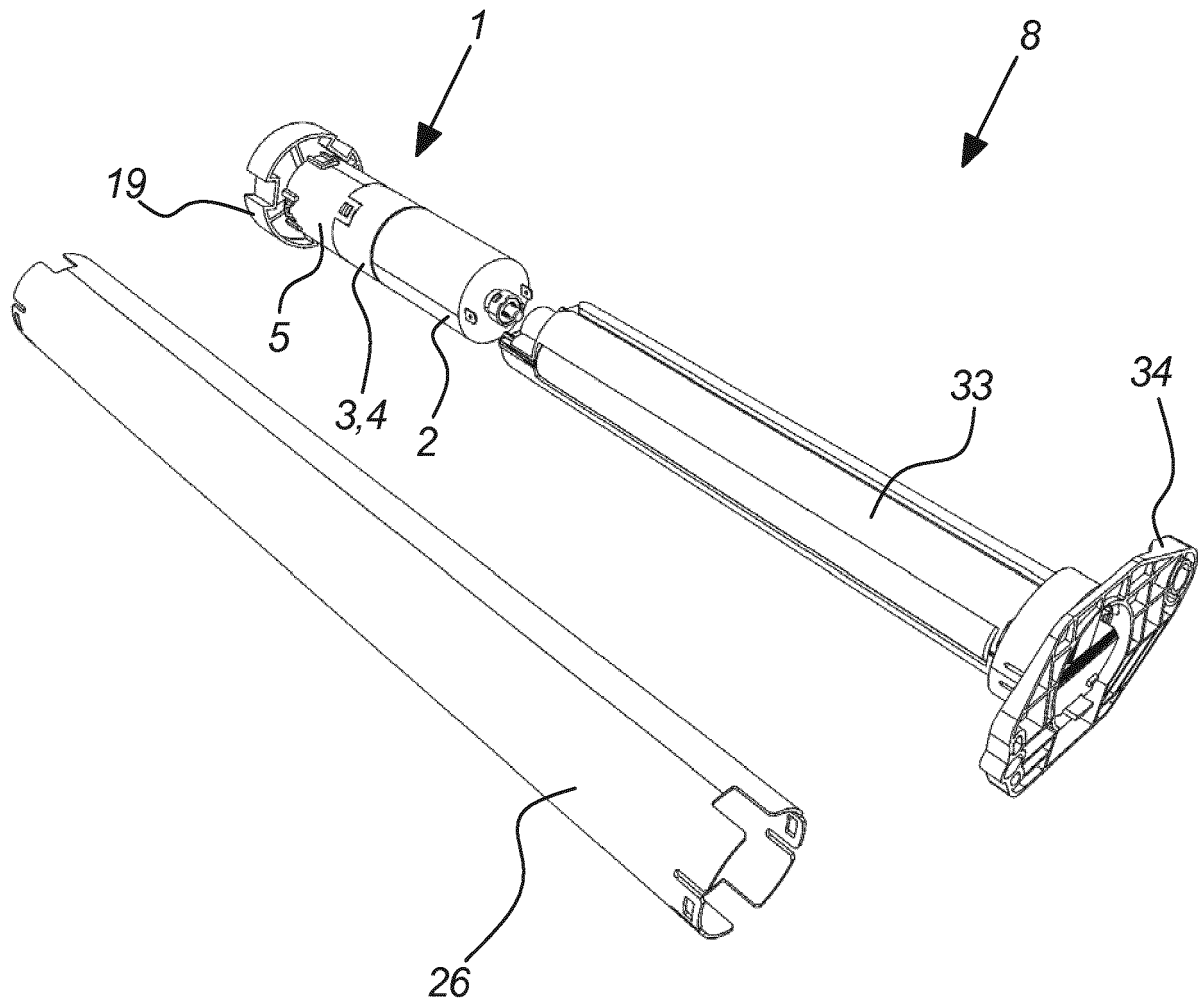


Fig. 5

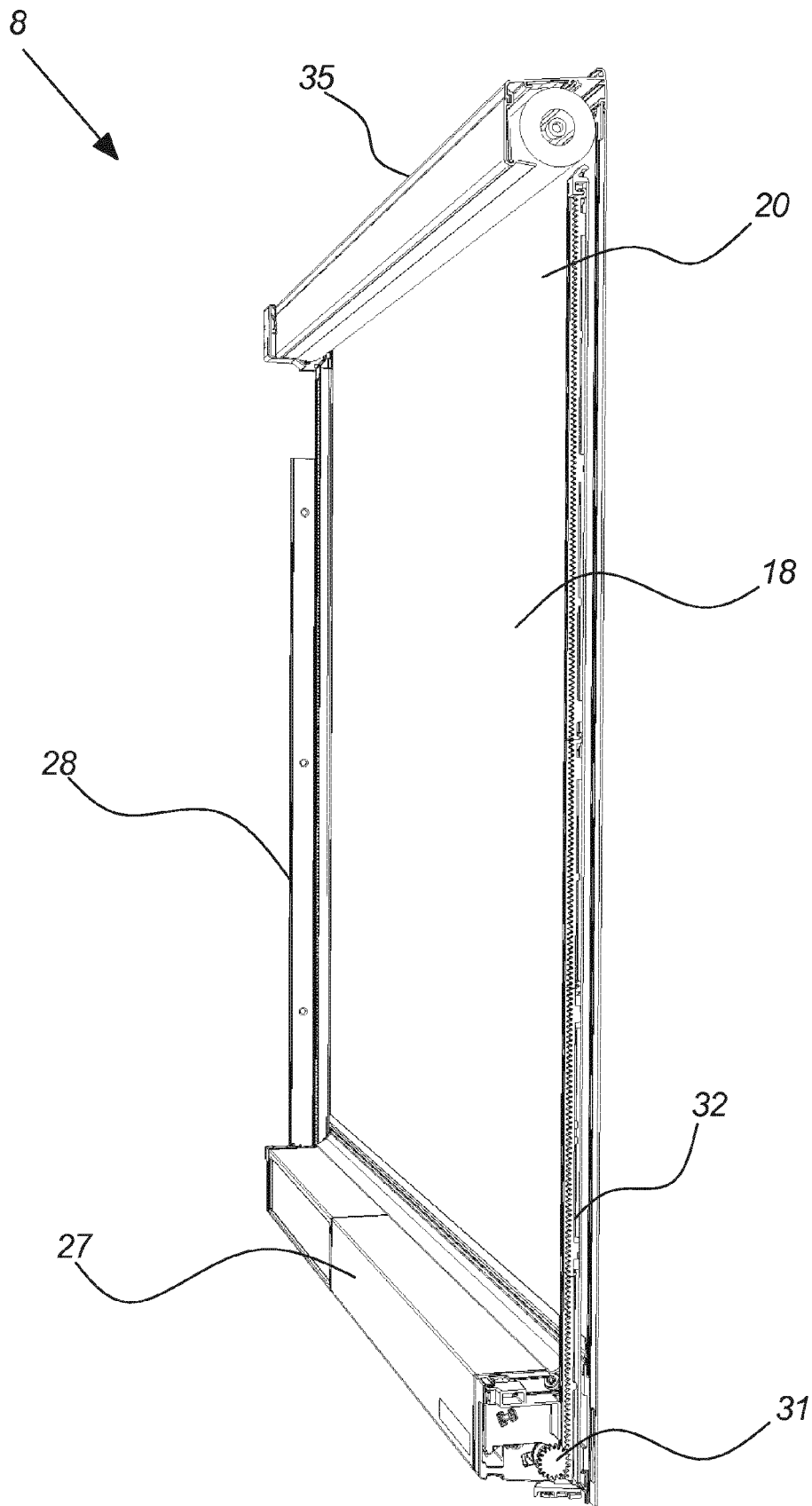


Fig. 6



EUROPEAN SEARCH REPORT

 Application Number
 EP 16 16 0145

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Place of search Munich		Date of completion of the search 19 August 2016	Examiner Kofoed, Peter
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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