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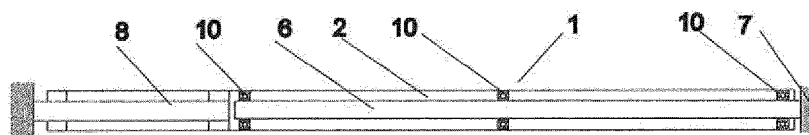


Fig. 5

(57) Abstract: A roller winding mechanism comprising a winding shaft (2) which is created as a tube attached at one end to a drive which is coupled to the frame (7) and at its other end mounted on a bearing on a pivot fixed to the frame (7), whereas it comprises a shaft reinforcement (6) which is inserted into a roller winding shaft (2) and anchored firmly to a frame (7) on the side opposite to a drive (8), the bending direction of the shaft reinforcement (6) being opposite to the expected deflection of the winding shaft (2) and the initial curvature of this reinforcement (6) is such that its deformation along its length is such that its axis at maximum deformation coincides with the axis of the originally non-deformed winding shaft (2) and the reinforcement (6) is provided with rolling support bearings (10) mutually spaced apart along its length.



ROLLER WINDING MECHANISM

TECHNICAL FIELD

[0001] The invention relates to a roller winding mechanism of various types of roller winding devices or roller shutters, such as fabric roller shutters, window roller shutters, roller garage doors, fire roller shutters, etc.

BACKGROUND OF THE INVENTION

[0002] Blinds are a type of shielding, which serves to effectively protect the interior especially from the sun's rays, but also as its attractive and practical decorative element. The blinds further may have an acoustic function, provide safety through fire retardants, can be used as a screen for projectors and as a light regulator. The blinds can be divided into indoor and outdoor in terms of arrangement with respect to the shaded area.

[0003] The basis of the roller blind winding mechanisms is a winding shaft onto which a screening element, such as lamella armour, fabric or foil, is wound. The size of the winding shaft is dimensioned to the weight of the winding shielding element and, especially in heavy fabric roller blinds, the deformation of the shaft is critical as it causes the undulation of the fabric which is considered to be a visual defect. Shaft size is usually limited by space for installation or cassette, in which the wound shielding element is hidden.

[0004] The shaft stiffness is determined mainly by its diameter, the maximum deflection can be determined according to the formula for the maximum deflection of the free beam with uniform continuous load:

$$w_{\max} = \frac{5ql^4}{384EJ}$$

where q is the continuous load [N/mm] - given by the weight of the rolled roller shutter plus the weight of the load plus the weight of the shaft itself,

l is the beam length [mm],

E is the Young's modulus [MPa],

J is the axial quadratic inertia moment of the cross-section [mm⁴].

[0005] Thus, the bending stiffness of the tubular shafts is determined by the type of material and the cross-sectional characteristics, with the use of rolled galvanised steel or drawn aluminium, exceptionally carbon composite, commonly used. In the case of pipes, the diameter is significantly influenced, but less the wall thickness, which mainly increases the weight of the winding shaft. The diameter of the winding shaft is a limiting factor for the maximum roller blind width and for large fabric roller blinds the shaft can be up to 160 mm in diameter, whilst for a conventional fabric roller blind for windows up to two metres wide, a pipe with 28mm diameter is sufficient. The consequence is a high weight of the whole device and the need for larger dimensioning of all related components. The ultimate consequence is the high cost, high demands on the size of the space and the bearing capacity of the anchoring for such a system. If the roller shutter is wide, the roller shutter must be solved and supported by brackets where the roller shutter is divided. Furthermore, if more windings are required on the winding shaft, it is generally necessary to use a smaller diameter winding shaft, which in turn leads to greater deflection and greater problems as described above.

[0006] US2014/US2014 / 0157547 discloses an electrical system for controlling a roller shaft. One end of an elastic band is firmly anchored on the shaft, with the remainder of the band being wound in a non-lowered blind state on a spool arranged on an axis parallel to the axis of the shaft. When the roller blind is lowered, this pre-tensioned belt is wound on the shaft and helps to fix the roller blind when the roller shutter stops. When rewinding, the belt is rewound on the spool by springing to help the electric motor. Thus, the electric motor may have lower power. The document does not solve the problem of the roller shaft deflection.

[0007] US2013/0333848 A1 discloses an electrical system for controlling a hollow shaft of a roller shutter. Inside the shaft there is a concentrically arranged carrier with a drive unit, which comprises an electric motor and a control unit, and next to this drive unit there is arranged a spring-loaded set of torsion springs in the axis of the carrier. These torsion springs are preloaded when lowering the roller shutter, and the accumulated energy of the springs helps to wind the roller shutter when winding the roller shutter. The above mentioned document also does not solve the problem of the roller shaft deflection.

[0008] WO2013/WO2013 / 129916 A1 discloses an electric roller blind control

system with two concentrically arranged drive units. Between the drive units, in the preferred embodiment, an auxiliary spring unit is wound concentrically on the carrier. This unit comprises a spring-loaded torsion spring, with one end of the spring wire attached to the carrier and the other end attached to the roller shaft. When the roller blind is lowered, this torsion spring preloads and when the roller blind is rolled back, the accumulated energy of the spring helps to wind the roller blind. Also, this document does not solve the problem of the roller shaft deflection.

[0009] It is an object of the present invention to provide a roller winding mechanism that eliminates unwanted deflection of the winding shaft, thereby eliminating the problems.

[0010] The preceding discussion of the background to the invention is intended only to facilitate an understanding of the present invention. It should be appreciated that the discussion is not an acknowledgment or admission that any of the material referred to was part of the common general knowledge as at the priority date of the application.

SUMMARY OF THE INVENTION

[0011] The above-mentioned drawbacks are eliminated by the roller winding mechanism according to the invention. The roller winding mechanism comprises a winding shaft which is created as a tube characterised in that the roller winding mechanism comprises a shaft reinforcement which is curved, which shaft reinforcement is provided with support bearings mutually spaced apart along the shaft reinforcement's length, which shaft reinforcement is inserted into the winding shaft so that the winding shaft can rotate independently from the shaft reinforcement, wherein the mechanism has an unloaded state and a loaded state, wherein in the unloaded state, the shaft reinforcement is curved with a central part of the shaft reinforcement being higher than its edge parts, and in the loaded state, a load element comprising at least a blind is applied to the mechanism and the shaft reinforcement is elastically straightened by weight of the load element.

[0012] In a preferred embodiment, it comprises a shaft reinforcement which is inserted into the roller shaft and anchored firmly to the frame on the side opposite to the drive, the bending direction of the shaft reinforcement being opposite to the expected deflection of the winding shaft and the initial curvature of this reinforcement is such that

its deformation along its length is such that its axis at maximum deformation coincides with the axis of the originally non-deformed winding shaft and the reinforcement is provided with rolling support bearings mutually spaced apart along its length.

[0013] In a preferred embodiment the reinforcement has the shape of a hollow or solid profile and between the inner diameter of the support bearings and the outer surface of the reinforcement there are shaped inserts with holes corresponding to the cross-sectional shape and size of the reinforcement and the cylindrical outer surface of the inserts corresponds to the shape and size of the inner surface of the inner ring of the support bearings to allow rotation of the winding shaft relative to the reinforcement.

[0014] The above-mentioned drawbacks are also eliminated by a kit suitable for constructing a roller winding mechanism according to the invention. The kit comprises a winding shaft which is created as a tube, a shaft reinforcement which is curved, which is configured to be inserted into the winding shaft, and rolling support bearings configured to be mutually spaced apart along a length of the shaft reinforcement. The mechanism has an unloaded state and a loaded state, wherein in the unloaded state, the shaft reinforcement is curved with a central part of the shaft reinforcement being higher than its edge parts, and in the loaded state, a load element comprising at least a blind is applied to the mechanism and the shaft reinforcement is elastically straightened by weight of the load element.

[0015] According to a first aspect of the invention there is provided a roller winding mechanism comprising a winding shaft which is created as a tube characterised in that the roller winding mechanism comprises a shaft reinforcement which is curved, which shaft reinforcement is provided with support bearings mutually spaced apart along the shaft reinforcement's length, which shaft reinforcement is inserted into the winding shaft so that the winding shaft can rotate independently from the shaft reinforcement, wherein the mechanism has an unloaded state and a loaded state, wherein in the unloaded state, the shaft reinforcement is curved with a central part of the shaft reinforcement being higher than its edge parts, and in the loaded state, a load element comprising at least a blind is applied to the mechanism and the shaft reinforcement is elastically straightened by weight of the load element.

[0016] Preferably, the winding shaft is attached at one end to a drive which is coupled to a frame, and at its other end the winding shaft is mounted on a bearing on a

pivot fixed to the frame, characterised in that the shaft reinforcement is anchored firmly to the frame on a side opposite to the drive, wherein curvature of the shaft reinforcement is such that the shaft reinforcement is straight in the loaded state.

[0017] Preferably, the shaft reinforcement has a shape of a hollow or solid profile and between an inner diameter of the support bearings and an outer surface of the shaft reinforcement there are shaped inserts with holes corresponding to a cross-sectional shape and size of the shaft reinforcement and an cylindrical outer surface of the inserts corresponds to shape and size of an inner surface of an inner ring of the support bearings to allow rotation of the winding shaft relative to the shaft reinforcement.

[0018] Preferably, the shaft reinforcement has a round or polygon shape in cross-section.

[0019] Preferably, the shaft reinforcement has a circular or regular polygon shape in cross-section.

[0020] Preferably, the winding shaft is made of aluminium, steel, preferably roll formed steel, or composites such as glass fibre.

[0021] Preferably, the shaft reinforcement is made of steel, preferably roll formed steel, composites, preferably glass fibre composites, or titanium.

[0022] Preferably, the winding shaft has an outer diameter smaller than 50 mm, preferably smaller than 45 mm, and a length of at least 4 m, preferably at least 5 m, suitable for supporting a linear weight of at least 1250 g/m.

[0023] Preferably, the winding shaft has an outer diameter smaller than 40 mm, preferably smaller than 30 mm, and a length of at least 3 m, preferably at least 4 m, suitable for supporting a linear weight of at least 500 g/m.

[0024] Preferably, the winding shaft has an outer diameter smaller than 100 mm, preferably smaller than 78 mm, and a length of at least 5 m, preferably at least 6 m, suitable for supporting a linear weight of at least 4000 g/m.

[0025] According to a first aspect of the invention there is provided a kit suitable for constructing a roller winding mechanism, comprising:

a winding shaft which is created as a tube,
a shaft reinforcement which is curved, which is configured to be inserted into the winding shaft, and
rolling support bearings configured to be mutually spaced apart along a length of the shaft reinforcement,
wherein the mechanism has an unloaded state and a loaded state, wherein in the unloaded state, the shaft reinforcement is curved with a central part of the shaft reinforcement being higher than its edge parts, and in the loaded state, a load element comprising at least a blind is applied to the mechanism and the shaft reinforcement is elastically straightened by weight of the load element.

[0026] Preferably, the kit suitable for constructing a roller winding mechanism further comprises a frame, wherein the winding shaft is attached at one end to a drive which is configured to be coupled to the frame and at its other end the winding shaft is mounted on a bearing on a pivot fixed to the frame, wherein the shaft reinforcement is anchored firmly to the frame on a side opposite to the drive, wherein curvature of the shaft reinforcement is such that the shaft reinforcement is straight in the loaded state.

[0027] Preferably, the shaft reinforcement is provided with the rolling support bearings mutually spaced apart along the shaft reinforcement's length and the drive is inserted into the roller winding shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] Further, features of the present invention are more fully described in the following description of several non-limiting embodiments thereof. This description is included solely for the purposes of exemplifying the present invention. It should not be understood as a restriction on the broad summary, disclosure or description of the invention as set out above. The description will be made with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of a roller winding mechanism, comprising a mounted winding shaft;

Fig. 2 is a schematic cross-sectional view of the entire roller shutter,

Fig. 3 is a schematic cross-sectional view of the roller winding shaft according to the prior art,

Fig. 4 is a view of a reinforcement of a roller blind winding mechanism according to the invention,

Fig. 5 is a cross-section of winding shaft reinforcing system disposed in the roller winding shaft of Fig. 1, and

Fig. 6 is a perspective view of a reinforcing system without a winding shaft.

DETAILED DESCRIPTION OF THE INVENTION

[0029] “Rolling support bearings” as described herein comprise any bearings which are suitable to allow a rotational movement of the winding shaft with respect to the fixed reinforcement shaft. These bearings may comprise rolling elements such as rolling-element bearings, but can also be plain bearings or rotational sliding bearings without moving or rolling elements.

[0030] The “yield strength” or “yield point” as described herein is defined with an offset yield point of 0.2% plastic strain.

[0031] In a first aspect, the invention relates to a roller winding mechanism comprising a winding shaft 2 which is created as a tube wherein the roller winding mechanism comprises a shaft reinforcement 6 which is curved, which shaft reinforcement is provided with support bearings 10 mutually spaced apart along its length, which shaft reinforcement 6 is inserted into said winding shaft 2 so that said winding shaft 2 can rotate independently from said shaft reinforcement 6.

[0032] In order to insert the curved reinforcement shaft, provided with support bearings, into the winding shaft, the curved reinforcement shaft will need to be straightened. This straightening of the reinforcement shaft is preferably an entirely elastic deformation. The elastic deformation of the reinforcement shaft will act as a weight countering force onto the winding shaft. This force is ideally opposite to the expected deformation of the winding shaft under any load. Typically, this load will be the result of the weight the roller blind system supports, in particular its own weight, the weight of any blinds connected thereto as well as any loads to straighten said blinds.

[0033] Whilst the force is ideally opposite to the expected deformation, so the force of the reinforcement shaft counters the weight acting upon the winding shaft entirely, even a non-ideal scenario is beneficial over the prior art. That is to say, the resulting force will be the vector sum of these forces. As long as the norm of the resulting vector is smaller than the norm of the weight acting on the winding shaft, the deflection by the winding shaft will be diminished considerably.

[0034] The reinforcement shaft thus results in a weight countering force acting onto the winding shaft. This force can easily be designed to be opposite to the weight acting on the winding shaft. As a result of these opposing forces, the stress due to the weight of the fabric on the roller shaft is significantly reduced. This improves the dimensional stability and rigidity of the roller shaft. In particular, it prevents hanging of the roller shaft under the weight of the fabric. This additionally allows the use of fabrics with a higher specific weight. It also allows the use of roller shafts with a lower diameter. It allows making roller winding mechanisms of a longer length. Lastly it advantageously allows the use of roller shafts with a lower Young modulus.

[0035] In a preferred embodiment, the straightening of the reinforcement shaft is an elastic deformation, that is to say below the yield point of the winding shaft. The stress applied on the reinforcement shaft which results in a plastic deformation of this shaft does not result in the desired weight countering force. It is only elastic deformation which produces the desired effect. Consequently, it is preferred that there is no plastic deformation on the winding or reinforcing shaft during the insertion of the reinforcement shaft or during operation.

[0036] Consequently, it is desired that the curved reinforcement shaft can be straightened, that is to say inserted into a straight winding shaft, without surpassing its yield point. In practical terms the offset yield point of 0.2% plastic strain should not be surpassed when inserting the curved reinforcement shaft into the winding shaft.

[0037] In a preferred embodiment, the roller winding mechanism according to the first aspect wherein the shaft reinforcement has a central part in between both ends, wherein the shaft reinforcement has an extremum in said central part.

[0038] An extremum as described herein comprises a point where the first derivative of curve that represents the shape of the curved reinforcement shaft with respect to the

axis of the winding shaft is zero. Said extremum can be either a minimum or a maximum. Having said extremum in said central region of the reinforcement shaft promotes the central acting of the weight countering force. Preferably the extremum of the reinforcement shaft coincides with a central region of the winding shaft once inserted. This is beneficial if the weight acting on the winding shaft is more or less centred. This is generally the case for winding shafts with blinds attached thereto.

[0039] In another preferred embodiment, the invention relates to a roller winding mechanism that comprises a shaft reinforcement which is inserted into the roller shaft and anchored firmly to the frame on the side opposite to the drive, the bending direction of the shaft reinforcement being opposite to the expected deflection of the winding shaft and the initial curvature of this reinforcement is such that its deformation along its length is such that its axis at maximum deformation coincides with the axis of the originally undeformed winding shaft and the reinforcement is provided with rolling support bearings spaced apart mutually along the length of winding shaft.

[0040] In this embodiment, the weight countering force and the weight acting on the winding shaft will counteract each other entirely. This is advantageous for maintaining a straight winding shaft, regardless of its length, diameter, yield modulus or the weight acting upon it.

[0041] In a preferred embodiment, the reinforcement has a round or polygon shape in cross-section. Polygon shapes are suitable for keeping the reinforcement fixed with respect to the rotationably layered roller winding mechanism. Round shapes are suitable for providing the reinforcement shaft with layers regardless of orientation of the rolling support bearings with respect to the reinforcement shaft. In a further preferred embodiment, the reinforcement has a circular or regular polygon shape in cross-section. A regular polygon shape is defined by equal angles and sides. A regular polygon shape is advantageous as it allows easier connection of the rolling support bearings onto the reinforcement shaft. Additionally, this allows the use of standard shapes for reinforcement shafts of different lengths and deflections with modular rolling support bearings.

[0042] In a preferred embodiment, the drive 8 is a motor, wherein said motor 8 is coupled to said winding shaft 2 and said frame 7. The motor is preferably an electrical motor. The motor is coupled so the winding shaft rotates, yet the frame and the

reinforcement shaft stay fixed, when the motor is actuated. In a preferred embodiment, the roller winding apparatus further comprises a power supply unit, electrically coupled to said motor and configured to supply power to said motor. In a further preferred embodiment, the motor is comprised within the winding shaft 2. This is considered more aesthetic, as the view for the consumer is limited to the winding shaft and blind. It delivers a motorised roller winding apparatus which doesn't hang or bend and doesn't have an additional box or connection.

[0043] In a preferred embodiment, the winding shaft is made of aluminium, steel preferably rolled form steel, composite materials such as glass fibre or other tubular materials. Aluminium is a strong, durable yet lightweight material. Reducing the weight of the roller winding apparatus is frequently desired and allows easier and more safe mounting of the roller winding apparatus to a surface.

[0044] In a preferred embodiment, the reinforcement shaft is made of a material with a high Young modulus. This is advantageous as materials with a higher Young modulus require less curvature and straightening for an equal weight countering force when straightened and inserted into the winding shaft. In a preferred embodiment, the young modulus is at least 180 GPa, preferably at least 190 GPa, more preferably at least 195 GPa, more preferably at least 200 GPa, most preferably at least 205 GPa.

[0045] In a preferred embodiment, the reinforcement shaft is made of a material with a high yield strength. Preferably, the yield strength measured to the offset yield point of 0.2% plastic strain $R_{p0.2}$ is at least 250 MPa, preferably at least 300 MPa, more preferably at least 350 MPa, more preferably at least 400 MPa, more preferably at least 450 MPa, more preferably at least 500 MPa, more preferably at least 550 MPa, more preferably at least 600 MPa, more preferably at least 650 MPa, more preferably at least 700 MPa, most preferably at least 750 MPa. A high yield strength is beneficial for producing a large weight countering force by a reinforcement shaft. This makes higher yield strengths beneficial for reinforcement shafts with a higher weight, longer length or smaller diameter.

[0046] In another preferred embodiment, the reinforcement shaft is made of steel, preferably roll formed steel, composite materials such as glass fibre or other tubular materials.

[0047] Steel has a high Young modulus and high yield strength. This is particularly advantageous for the reinforcement shaft. In a more preferred embodiment, high strength alloys such as ASTM A514 steel are used.

[0048] The preferred shape of the reinforcement shaft, before inserting into the winding shaft, will now be described in more detail. If we represent the central axis of the reinforcement shaft as a curve, this curve is preferably planar. That is to say it fits within a plane. This is beneficial for counterbalancing unidirectional forces. As weight, due to the nature of gravity, can be considered a unidirectional force for this purpose regardless of the orientation of the blinds, it is beneficial for the axis of the reinforcement shaft to be a planar curve.

[0049] In a preferred embodiment, at least a central part of the axis of the reinforcement shaft can be fitted to a catenary shape. More preferably, the shaft can be fitted to a weighted catenary shape. In particular, this weighted catenary shape can be represented by the curve $y = a \cosh(x/b)$, wherein \cosh is the hyperbolic cosine function, x and y are variables representing the curve and a and b are parameters. If $a=b$ then the catenary is not weighted. This can be used as approximation if the winding shaft weights significantly more than the blinds. However, if the weight of the winding shaft and reinforcement shaft is small compared to the total weight acting on the winding shaft, a and b should be treated as independent parameters.

[0050] This shape is preferred as any force of tension or compression exerted onto the winding shaft with said shape is parallel to the shape, offset by the weight it is to support. These curves are known in the arts for distribution of weight and / or stress along an arc.

[0051] In another embodiment, when representing at least a central part of the axis of the reinforcement shaft as a curve, this curve can be approximated by the shape of a parabola, represented by the curve $y = ax^2$. In a preferred embodiment, the ideal catenary can be approximated by a Taylor expansion. More preferably, said Taylor expansion only comprises components with an even exponent. This is preferable to obtain a symmetrical curve. The reinforcement shaft is preferably symmetrical assuming the winding shaft is to hang perpendicular to gravity. Approximating the shape of the reinforcement shaft as a parabola or Taylor series is easier to control and model, thus allows for easier production.

[0052] The reinforcement shaft comprises a central part and two ends. The central part is, as described above, ideally fitted to a certain curve. However, the ends do not need to conform to said curve. These ends may be curved differently. These ends may be straight, in order to allow for easy fixation with respect to a frame, suitable to keep the reinforcement shaft in place.

[0053] The winding shafts according to the invention will be defined in function of the linear weight they can support. This linear weight is considered to approximate the weight of a blind, possibly with additional loads. As such, it is measured or tested for loads which are uniform and span the entire length of the winding shaft. The height of a blind, the specific weight of a blind and the additional weight of a possible load attached to the blind can be calculated from this.

[0054] In a preferred embodiment, the winding shaft has an outer diameter smaller than 50 mm, preferably smaller than 47 mm, most preferably smaller than 45 mm, and a length of at least 4 m, preferably at least 4.5 m, most preferably at least 5 m. This is suitable for supporting a linear weight of at least 1250 g/m.

[0055] In a preferred embodiment, the winding shaft has an outer diameter smaller than 40 mm, preferably smaller than 35 mm, more preferably smaller than 32 mm, most preferably smaller than 30 mm, and a length of at least 3.5 m, preferably at least 4 m, most preferably at least 4.5 m. This is suitable for supporting a linear weight of at least 500 g/m.

[0056] In a preferred embodiment, the winding shaft has an outer diameter smaller than 100 mm, preferably smaller than 80 mm, more preferably smaller than 78 mm, most preferably smaller than 75 mm, and a length of at least 5 m, preferably at least 6 m, most preferably at least 7 m. This is suitable for supporting a linear weight of at least 4000 g/m.

[0057] These preferred embodiments allow hanging blinds with a high linear weight onto long winding shafts with a low outer diameter. This allows the roller blind apparatus to be condensed into a smaller space and look aesthetically pleasing. Despite this, the winding shaft will not bend under the linear weight over time due to the reinforcement shaft. For the same tube length and diameter, being able to support a higher linear weight is advantageous to provide blinds which are for example longer or have a higher

specific weight. Blinds with a higher specific weight allow the use of heavier materials which might be warmer, better insulated, less translucent or simply to provide more options.

[0058] In a second aspect the invention relates to a kit suitable for constructing a roller winding mechanism, comprising:

- a winding shaft 2 which is created as a tube,
- a shaft reinforcement 6 which is curved, which is configured to be inserted into the winding shaft 2, and
- rolling support bearings 10 configured to be mutually spaced apart along the length of the shaft reinforcement 6.

[0059] In a preferred embodiment of the second aspect, the invention relates to a kit suitable for constructing a roller winding mechanism, comprising:

- a frame 7,
- a winding shaft 2 which is created as a tube attached at one end to a drive 8 which is configured to be coupled to the frame 7 and at its other end mounted on a bearing on a pivot fixed to the frame 7,
- a shaft reinforcement 6 which is configured to be inserted into a roller winding shaft 2 and anchored firmly to said frame 7 on the side opposite to said drive 8, the bending direction of the shaft reinforcement 6 being opposite to the expected deflection of the winding shaft 2 and the initial curvature of this reinforcement 6 is such that its deformation along its length is such that its axis at maximum deformation coincides with the axis of the originally non-deformed winding shaft 2, and
- rolling support bearings 10 configured to be mutually spaced apart along the length of the shaft reinforcement 6.

[0060] The kit of the second aspect can advantageously be used to construct and mount a roller winding mechanism according to the first aspect. Furthermore, this kit may be used with various types of blinds if so desired. This allows the kit to be used as a modular piece along with various different blinds, which may have different weights, specific weights or densities, heights, colours and textures.

[0061] In a preferred embodiment, the kit further comprises a blind 4 suitable for attaching to said winding shaft 2. In a more preferred embodiment, kit comprises a blind

which is attached to said winding shaft. Preferably the blind is rolled around said winding shaft. In another preferred embodiment, the shaft reinforcement 6 is provided with said rolling support bearings 10 mutually spaced apart along its length and said drive 8 are inserted into said roller winding shaft 2. The pre-construction of the blind and winding shaft assembly and / or the construction of the reinforcement and winding shaft assembly makes the construction and mounting of the roller winding apparatus easier. It furthermore prevents mistakes in construction by the consumer or roller blind expert mounting said roller blind apparatus.

[0062] In Fig. 1, there is a perspective view of winding shaft 2 of the roller blind, which is part of the roller winding mechanism 1. This can be seen in detail in Figs. 5 and 6. A protruding part of the drive 8 can be seen. On the surface of the winding shaft 2 an anchoring groove 11 can be provided longitudinally for anchoring one end of the wound roller blind.

[0063] Fig. 2 is a schematic side view of an embodiment of a roller blind. The basis is the winding shaft 2 onto which a screening element 4, which is a lamellar armour, fabric or a foil, is wound, which is provided at its free end with a load 5 to be tensioned. The wound screening element 4 is hidden in the cassette 3. A dotted line indicates the cross-section of a reinforcement 6, which will be discussed later. Fig. 3 shows the winding shaft 2 according to the prior art slightly deformed by its own weight, the weight of the screening element 4 and the weight of the load 5. The arrow A indicates the deflection direction of the winding shaft 2. The winding shaft 2 is connected at one end to the drive 8 which is connected to a frame 7 or to the wall and at the other end is connected to a pin 13 which is fixed to the frame 7. Anchoring bearing 9 is provided on the pin 13 with its inner ring, whereas on the outer ring the winding shaft 2 is arranged with its inner diameter. The drive 8 may be manual or with an electric motor.

[0064] Fig. 4 shows a curved or prestressed shaft reinforcement 6 which is part of the winding mechanism 1 according to the invention. This reinforcement 6 increases the stiffness of the shaft 2 in the bending plane. The shaft reinforcement 6 is inserted into the roller shaft 2 and anchored firmly to the frame 7 on the opposite side to the drive 8, so that it does not rotate and still counteracts the force causing the shaft 2 to deflect even when rotated. The direction of deflection of the shaft reinforcement 6 is indicated by the arrow B and is opposite to the expected deflection of the winding shaft 2. The

initial curvature or prestressing of this reinforcement 6 is chosen so that its deformation along its length is such, that its axis at maximum deformation will coincide with that originally non-deformed winding shafts 2 and therefore the winding shaft 2 is arranged as straight during operation. Fine-tuning or compensating for the remaining deformation after inserting the reinforcement 6 is done by adjusting the weight or distributing the load 5.

[0065] Fig. 5 is a schematic cross-sectional view of the roller winding mechanism 1 arranged in the winding shaft 2 of the roller shutter of Figure 1. The shaft reinforcement 6 is anchored at the opposite edge to the drive 8. The reinforcement 6 replaces the function of the pin 13. The winding shaft 2 is supported by the bearings 10 spaced mutually apart along the length by the, so that the winding shaft 2 can rotate around the stationary reinforcement 6.

[0066] Fig. 6 shows a perspective view of the uncovered roller winding mechanism 1 and the arrangement of the support bearing 10 at the edge of the reinforcement 6 and the placement of further support bearings 10 along the length of the reinforcement 6 can be clearly seen. The support bearings 10 are designed as rolling bearings and are mutually spaced apart at certain distances along the length. The reinforcement 6 preferably has a round, square, rectangular or polygonal cross-section, and on the inner diameters of the support bearings 10 and on the outer surface of the reinforcement 6 inserts 12 are formed having an aperture corresponding to the shape and size of the outer surface of the reinforcement 6 of the winding shaft 2, and a cylindrical outer surface corresponding to the shape and size of the inner surface of the inner ring of the bearings 10 to allow rotation of the winding shaft 2 relative to the reinforcement 6.

INDUSTRIAL APPLICABILITY

[0067] Roller winding mechanism can be applied wherever it is necessary to increase the resistance of the winding shaft against deflection caused by unidirectional load, especially for various roller blind shading systems such as fabric roller blinds, screen blinds, roller window, shutter blinds, roller garage doors and roller shutters especially of large width. It can be used wherever there is an excessive unwanted deflection of the winding shaft, where a larger amount of fabric needs to be wound and it is necessary to use a smaller diameter shaft, where long shafts need to be used or where larger shaft diameter cannot be used with regard to installation dimensions or

size of the cassette and therefore the winding shaft needs to be reinforced.

[0068] The invention is further described by the following non-limiting examples which further illustrate the invention, and are not intended to, nor should they be interpreted to, limit the scope of the invention.

EXAMPLES

EXAMPLE 1

[0069] A roller blind using an aluminium tube with a diameter of 47 mm and a length of 5.0 metres is used. Inserted into this tube is a steel, curved reinforcement shaft provided with 8 plain bearings spread along its length. The curvature of the central part of the reinforcement was shaped as a weighted catenary. Attached to this winding tube is a fabric with a height of 2.700 metres and a specific weight of 450 gram per square metre.

EXAMPLE 2

[0070] A roller blind using an aluminium tube with a diameter of 32 mm and a length of 4 metres is used. Inserted into this tube is a steel, curved reinforcement shaft provided with 6 plain bearings spread along its length. Attached to this winding tube is a fabric with a height of 2.700 metres and a specific weight of 150 gram per square metre.

EXAMPLE 3

[0071] A roller blind mechanism using a roll formed steel tube with a diameter of 78 mm and a length of 6 metres is used. Inserted into this tube is a steel, curved reinforcement shaft provided with 12 rolling element bearings spread along its length. Attached to this winding tube is a fabric with a height of 3 metres and a specific weight of 1200 gram per square metre.

EXAMPLE 4

[0072] A roller blind mechanism using a roll formed steel tube with a diameter of 63 mm and a length of 6 metres is used. Inserted into this tube is a steel, curved reinforcement shaft provided with rolling element bearings spread along its length.

Attached to this winding tube is a fabric with a height of 6 metres and a specific weight of 600 gram per square metre.

EXAMPLE 5

[0073] A building kit for the roller blind of 3 is provided. The kit is provided in a box of 6.10 metres by 103 mm by 103 mm. The kit is provided with or without guide profiles and guide cables to attach the tube. The tube is delivered with or without electric motor within the winding tube. When delivered with an electric motor, the steel, curved reinforcement is shortened. However, it is curved more to offset the reduced length.

EXAMPLE 6

[0074] A building kit for the roller blind of 3 is provided. The kit is provided in a box of 6.10 metres by 131 mm by 131 mm. The kit is provided with or without guide profiles and guide cables to attach the tube. The tube is delivered with or without electric motor within the aluminium winding tube. When delivered with an electric motor, the steel, curved reinforcement is shortened. However, it is curved more to offset the reduced length.

[0075] Modifications and variations such as would be apparent to the skilled addressee are considered to fall within the scope of the present invention. The present invention is not to be limited in scope by any of the specific embodiments described herein. These embodiments are intended for the purpose of exemplification only. Functionally equivalent products, formulations and methods are clearly within the scope of the invention as described herein. It will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

[0076] Example embodiments are provided so that this disclosure will be thorough, and will fully convey the scope to those who are skilled in the art. Numerous specific details are set forth such as examples of specific components, devices, and methods, to provide a thorough understanding of embodiments of the present disclosure. It will be apparent to those skilled in the art that specific details need not be employed, that example embodiments may be embodied in many different forms and that neither should be construed to limit the scope of the disclosure. In some example

embodiments, well-known processes, well-known device structures, and well-known technologies are not described in detail.

[0077] Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

[0078] The method steps, processes, and operations described herein are not to be construed as necessarily requiring their performance in the particular order discussed or illustrated, unless specifically identified as an order of performance. It is also to be understood that additional or alternative steps may be employed.

[0079] Reference to positional descriptions and spatially relative terms, such as “inner”, “outer”, “beneath”, “below”, “lower”, “above”, “upper” and the like, are to be taken in context of the embodiments depicted in the figures, and are not to be taken as limiting the invention to the literal interpretation of the term but rather as would be understood by the skilled addressee.

[0080] Although the terms first, second, third, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms may be only used to distinguish one element, component, region, layer or section from another region, layer or section. Terms such as “first”, “second”, and other numerical terms when used herein do not imply a sequence or order unless clearly indicated by the context. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the example embodiments.

[0081] It will be understood that when an element is referred to as being “on”, “engaged”, “connected” or “coupled” to another element/layer, it may be directly on, engaged, connected or coupled to the other element/layer or intervening elements/layers may be present. Other words used to describe the relationship between elements/layers should be interpreted in a like fashion (e.g. “between”, “adjacent”). As used herein the term “and/or” includes any and all combinations of one or more of the associated listed items.

[0082] The terminology used herein is for the purpose of describing particular example embodiments only and is not intended to be limiting. As used herein, the singular forms “a”, “an” and “the” may be intended to include the plural forms as well, unless the context clearly indicates otherwise. The terms “comprise”, “comprises”, “comprising”, “including”, and “having”, or variations thereof are inclusive and therefore specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

CLAIMS

1. A roller winding mechanism comprising a winding shaft which is created as a tube characterised in that the roller winding mechanism comprises a shaft reinforcement which is curved, which shaft reinforcement is provided with support bearings mutually spaced apart along the shaft reinforcement's length, which shaft reinforcement is inserted into the winding shaft so that the winding shaft can rotate independently from the shaft reinforcement, wherein the mechanism has an unloaded state and a loaded state, wherein in the unloaded state, the shaft reinforcement is curved with a central part of the shaft reinforcement being higher than its edge parts, and in the loaded state, a load element comprising at least a blind is applied to the mechanism and the shaft reinforcement is elastically straightened by weight of the load element.
2. The roller winding mechanism according to claim 1 wherein the winding shaft is attached at one end to a drive, which is coupled to a frame, and at its other end the winding shaft is mounted on a bearing on a pivot fixed to the frame, characterised in that the shaft reinforcement is anchored firmly to the frame on a side opposite to the drive, wherein curvature of the shaft reinforcement is such that the shaft reinforcement is straight in the loaded state.
3. The roller winding mechanism according to any of the claim 1-2, characterised in that the shaft reinforcement has a shape of a hollow or solid profile and between an inner diameter of the support bearings and an outer surface of the shaft reinforcement there are shaped inserts with holes corresponding to a cross-sectional shape and size of the shaft reinforcement and an cylindrical outer surface of the inserts corresponds to shape and size of an inner surface of an inner ring of the support bearings to allow rotation of the winding shaft relative to the shaft reinforcement.
4. The roller winding mechanism according to any of the claims 1-3, wherein the shaft reinforcement has a round or polygon shape in cross-section.
5. The roller winding mechanism according to any of the claims 1-4, wherein the shaft reinforcement has a circular or regular polygon shape in cross-section.

6. The roller winding mechanism according to any of the claims 1-5, wherein the winding shaft is made of aluminium, steel, preferably roll formed steel, or composites such as glass fibre.
7. The roller winding mechanism according to any of the claims 1-6, wherein the shaft reinforcement is made of steel, preferably roll formed steel, composites, preferably glass fibre composites, or titanium.
8. The roller winding mechanism according to any of the claims 1-7, wherein the winding shaft has an outer diameter smaller than 50 mm, preferably smaller than 45 mm, and a length of at least 4 m, preferably at least 5 m, suitable for supporting a linear weight of at least 1250 g/m.
9. The roller winding mechanism according to any of the claims 1-7, wherein the winding shaft has an outer diameter smaller than 40 mm, preferably smaller than 30 mm, and a length of at least 3 m, preferably at least 4 m, suitable for supporting a linear weight of at least 500 g/m.
10. The roller winding mechanism according to any of the claims 1-7, wherein the winding shaft has an outer diameter smaller than 100 mm, preferably smaller than 78 mm, and a length of at least 5 m, preferably at least 6 m, suitable for supporting a linear weight of at least 4000 g/m.
11. A kit suitable for constructing a roller winding mechanism, comprising:
 - a winding shaft which is created as a tube,
 - a shaft reinforcement which is curved, which is configured to be inserted into the winding shaft, and
 - rolling support bearings configured to be mutually spaced apart along a length of the shaft reinforcement,wherein the mechanism has an unloaded state and a loaded state, wherein in the unloaded state, the shaft reinforcement is curved with a central part of the shaft reinforcement being higher than its edge parts, and in the loaded state, a load element comprising at least a blind is applied to the mechanism and the shaft reinforcement is elastically straightened by weight of the load element.

12. The kit suitable for constructing a roller winding mechanism according to claim 11, comprising a frame, wherein the winding shaft is attached at one end to a drive which is configured to be coupled to the frame and at its other end the winding shaft is mounted on a bearing on a pivot fixed to the frame, wherein the shaft reinforcement is anchored firmly to the frame on a side opposite to the drive, wherein curvature of the shaft reinforcement is such that the shaft reinforcement is straight in the loaded state.
13. A kit according to claim 12, wherein the shaft reinforcement is provided with the rolling support bearings mutually spaced apart along the shaft reinforcement's length and the drive is inserted into the roller winding shaft.

FIGURES

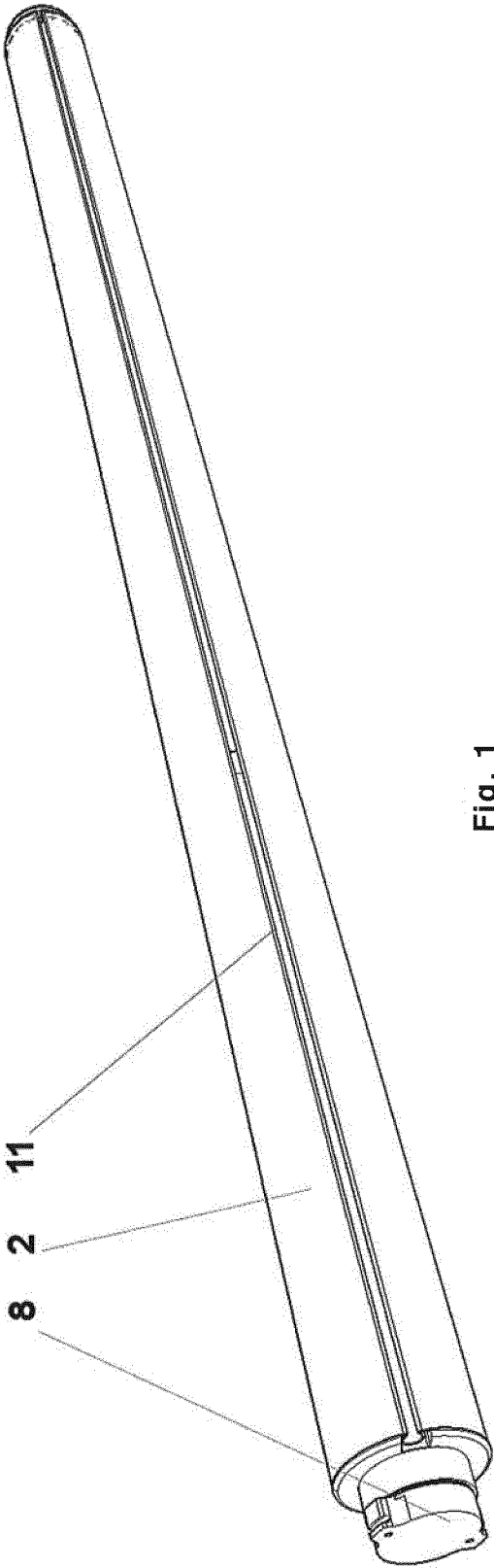


Fig. 1

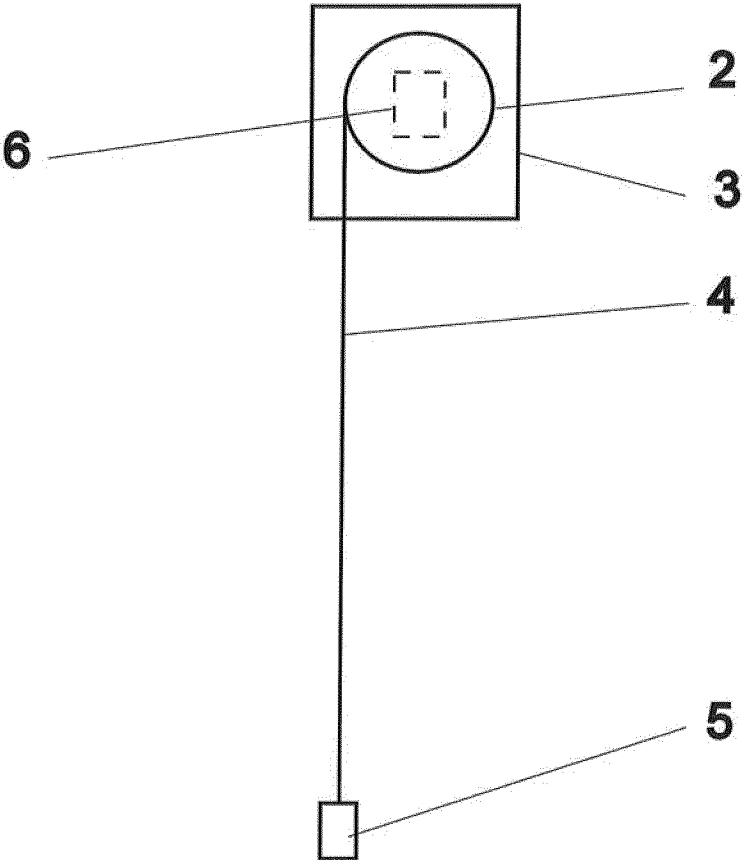


Fig. 2

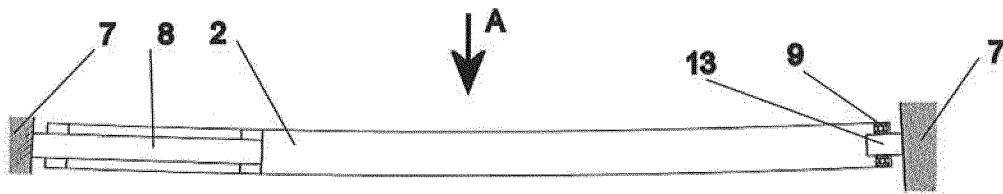


Fig. 3

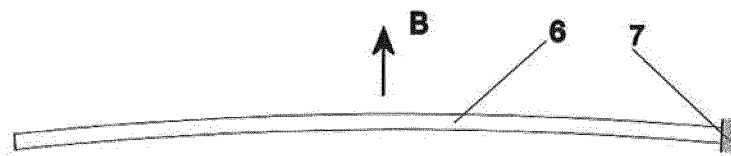


Fig. 4

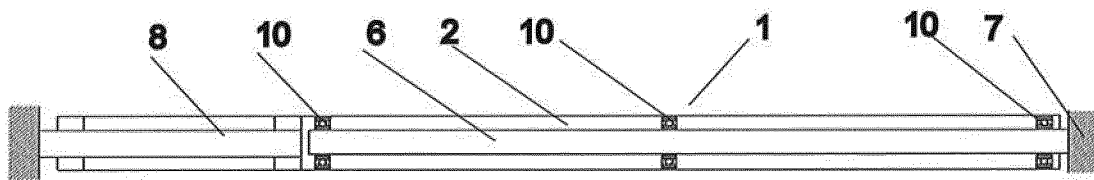


Fig. 5

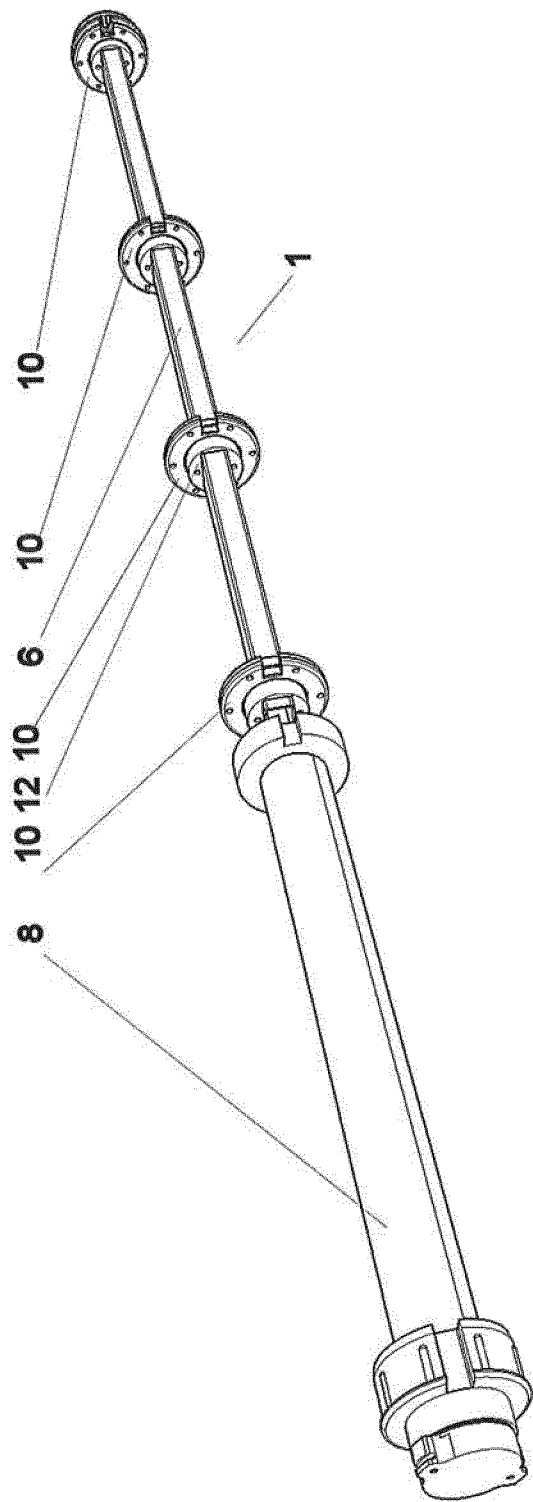


Fig. 6