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(54) ROLLER SHADE MOUNTING SYSTEM

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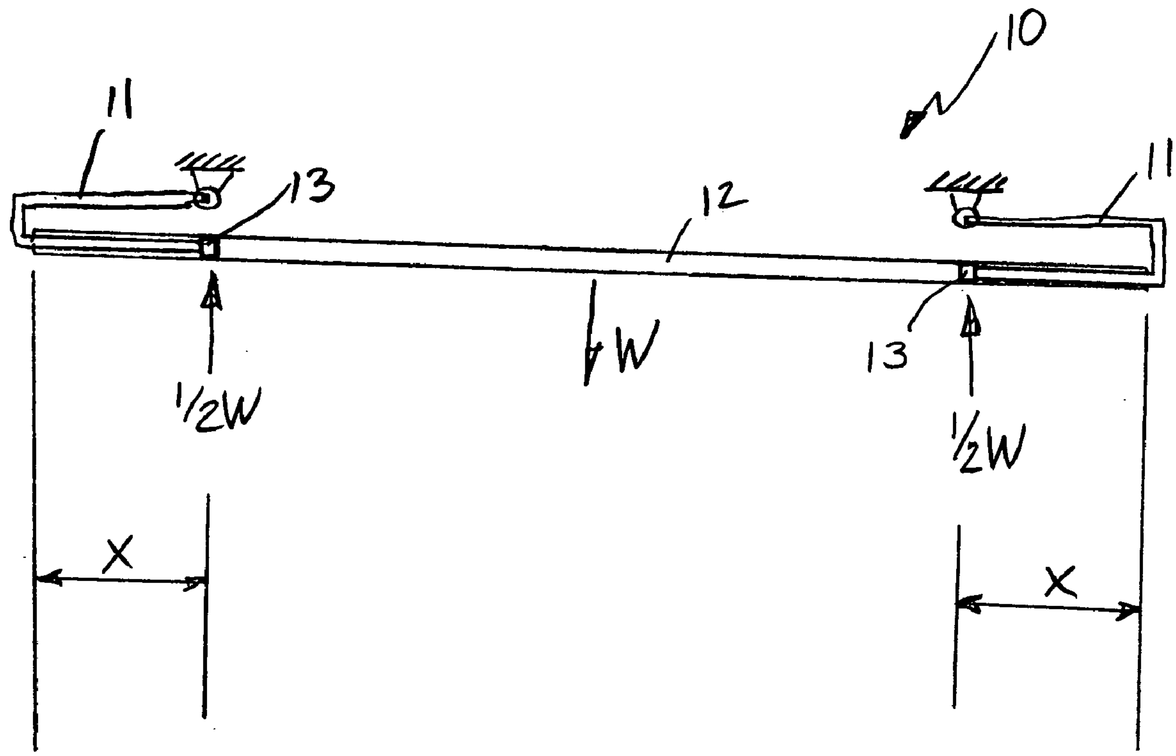
(57) ABSTRACT

A roller shade mounting system includes a pair of assemblies for limiting sagging in a roller shade tube. The assembly includes a single bearing supported by a shaft to position the bearing at a distance from an end of the tube. Alternatively, the assembly includes a bearing pair supported by a shaft to define spaced support points for applying a reaction moment the roller tube. The assembly further includes an attachment member secured to the shaft at a first end and to the structure at an opposite second end, either directly, or to a mounting bracket secured to the structure. The mounting assembly may further include a deflection adjustment member engaging the attachment member and a fixed support member to provide variable control of roller tube deflection.



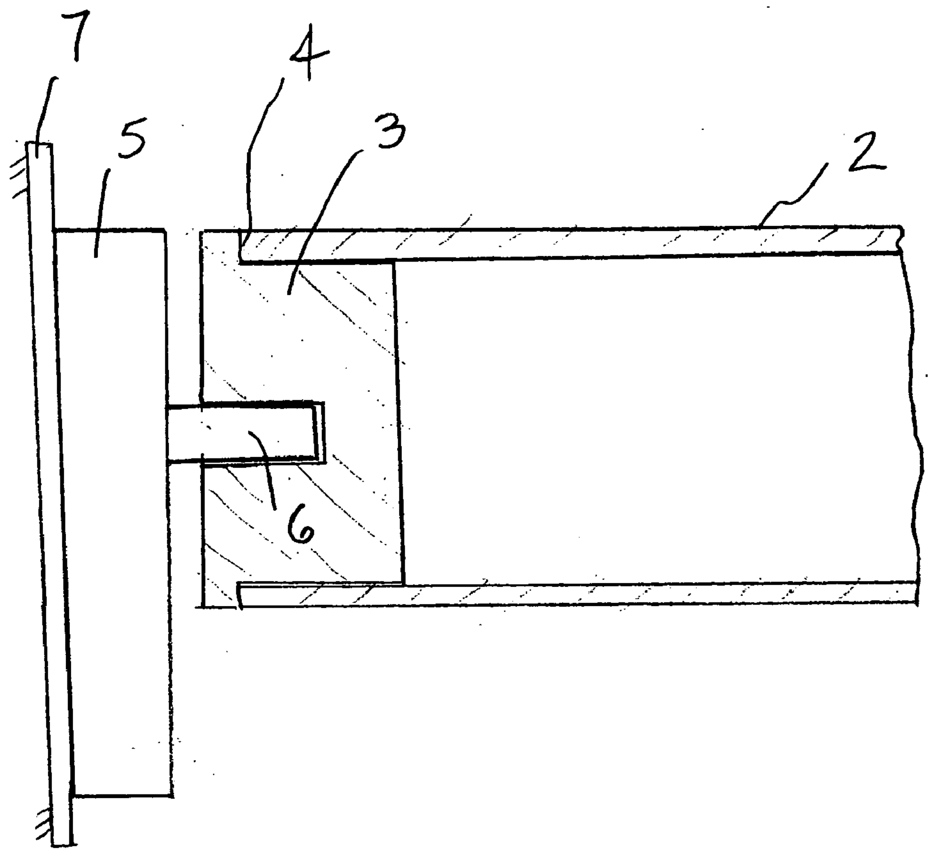


FIG. 1 (Prior Art)

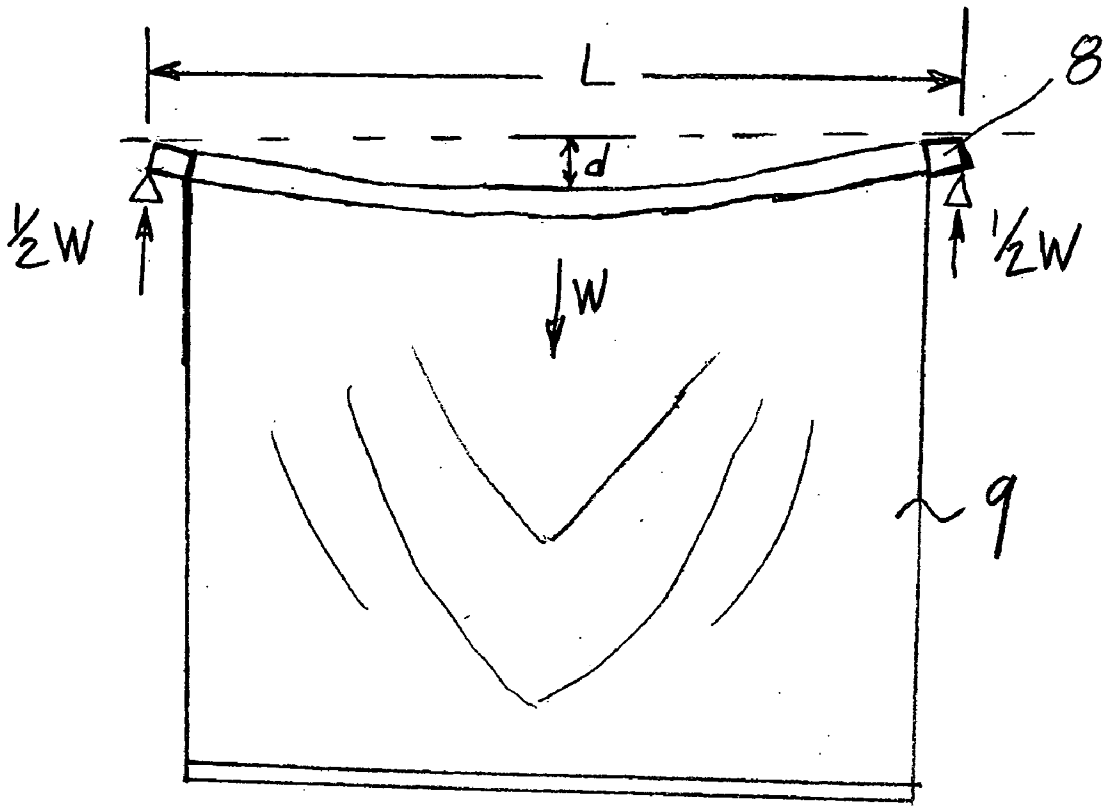


FIG. 2 (Prior Art)

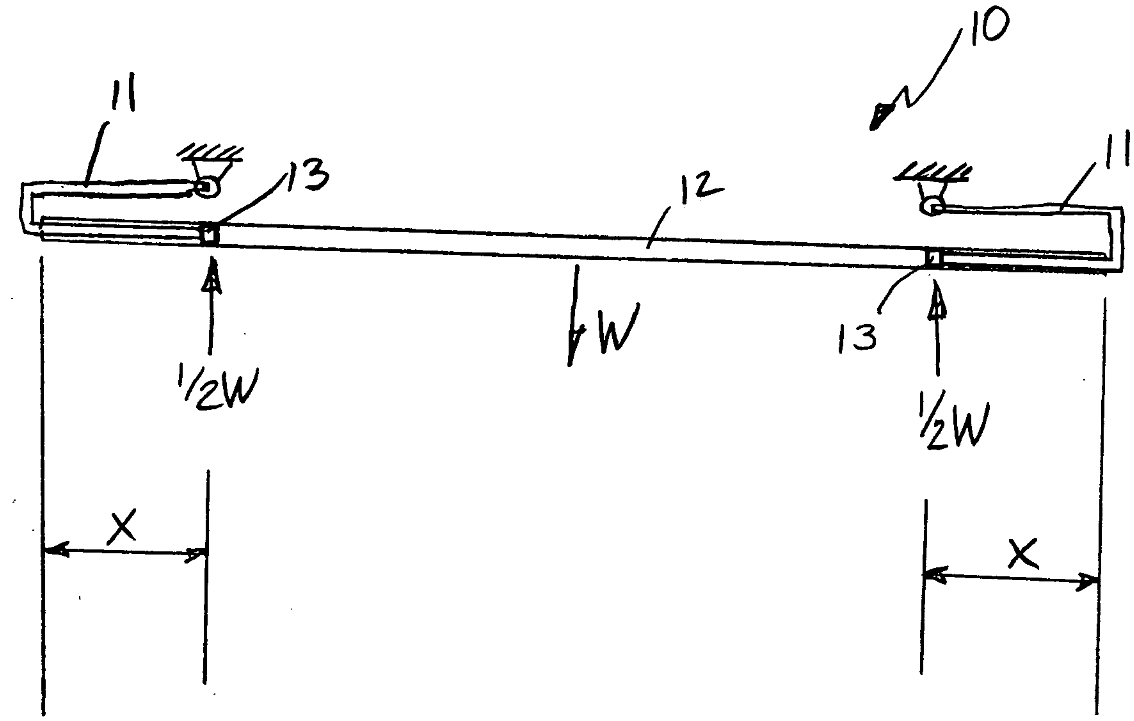


FIG. 3

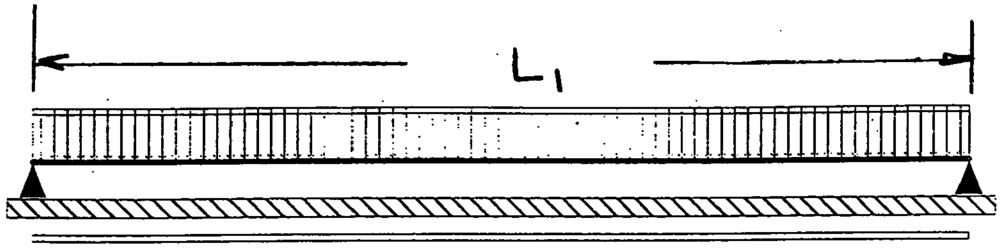


FIG. 4A

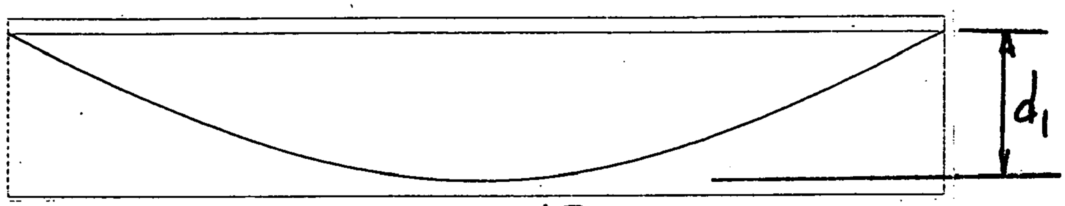


FIG. 4B

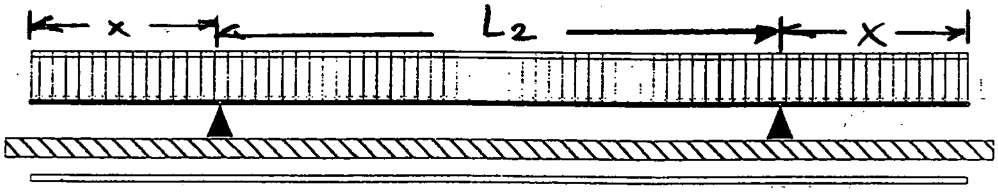


FIG. 4C

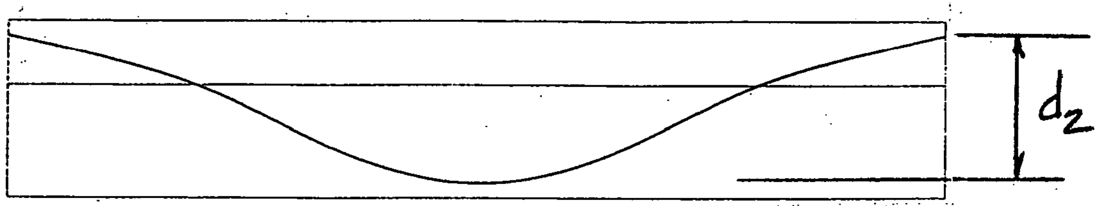


FIG. 4D

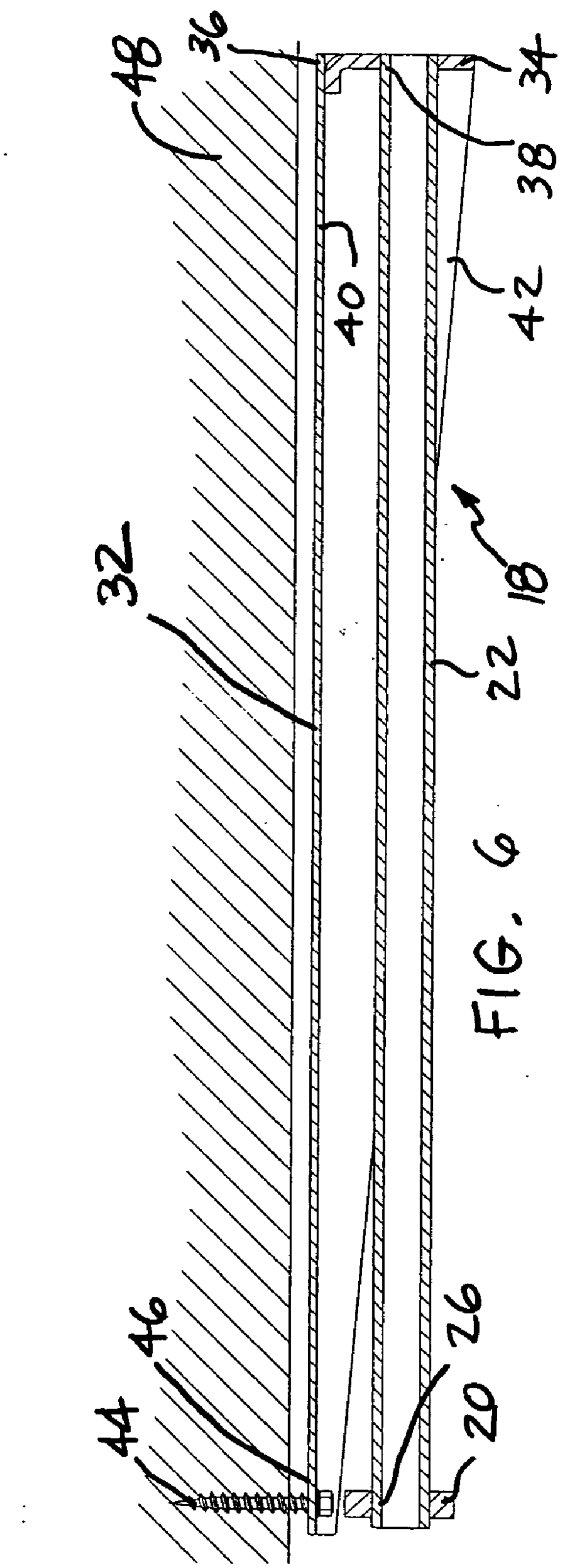


FIG. 6

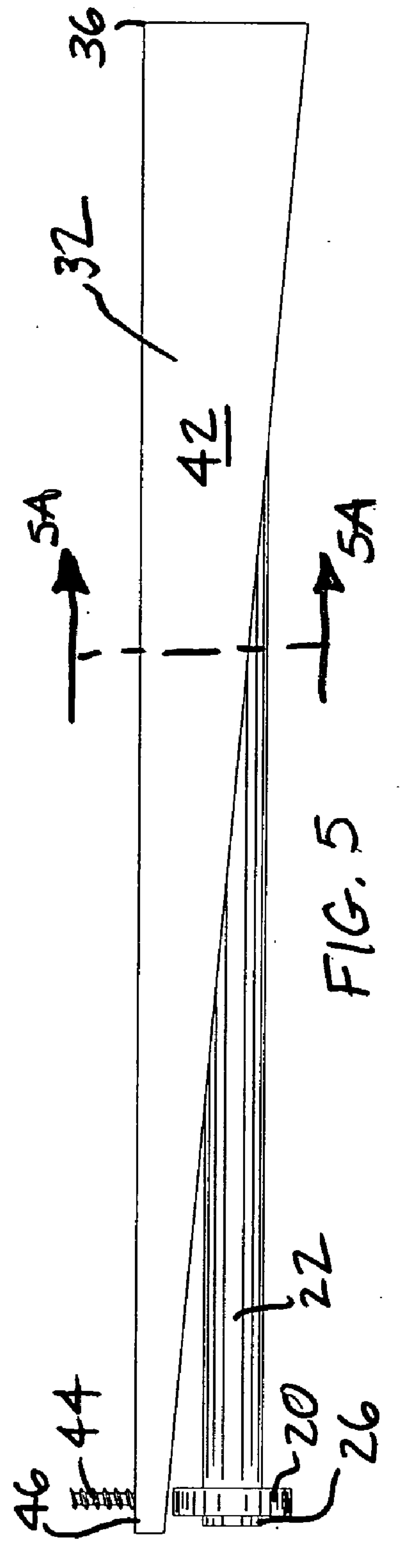


FIG. 5

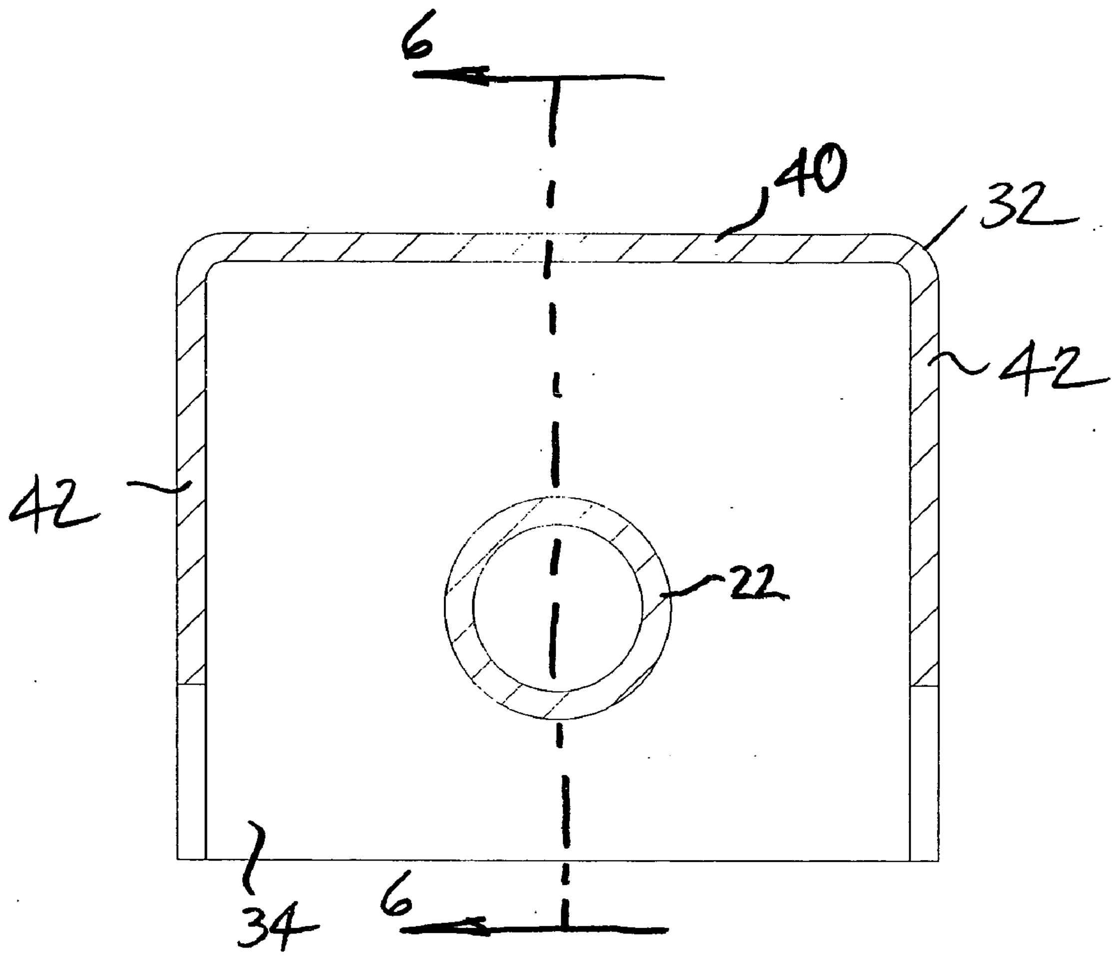


FIG. 5A

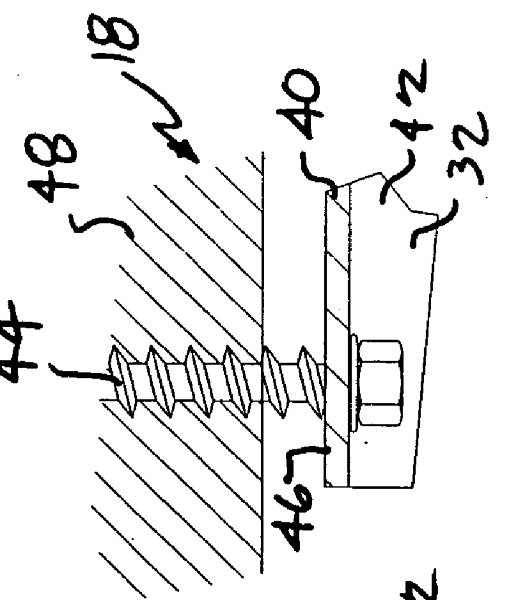


FIG. 7

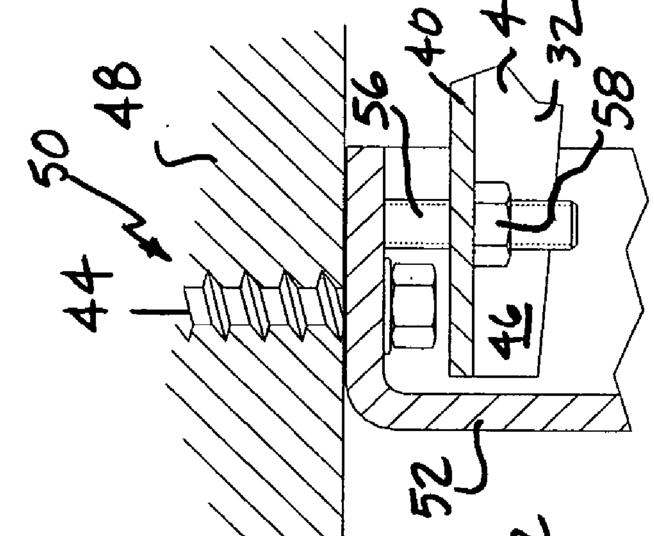


FIG. 8

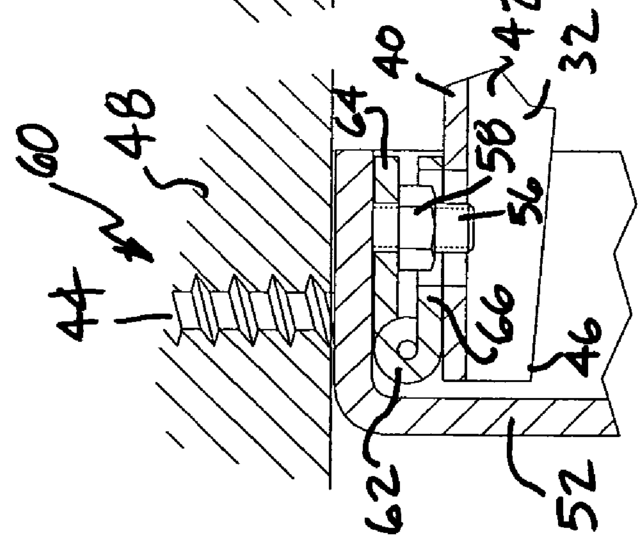


FIG. 9

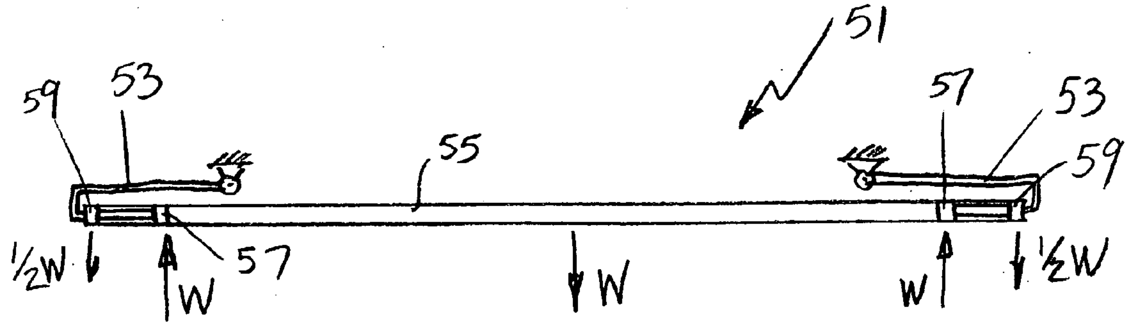


FIG. 10

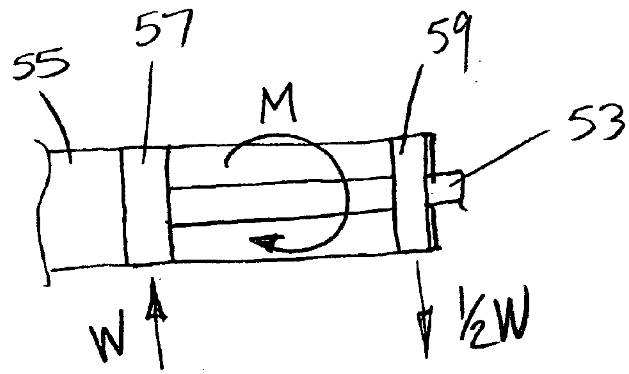


FIG. 11

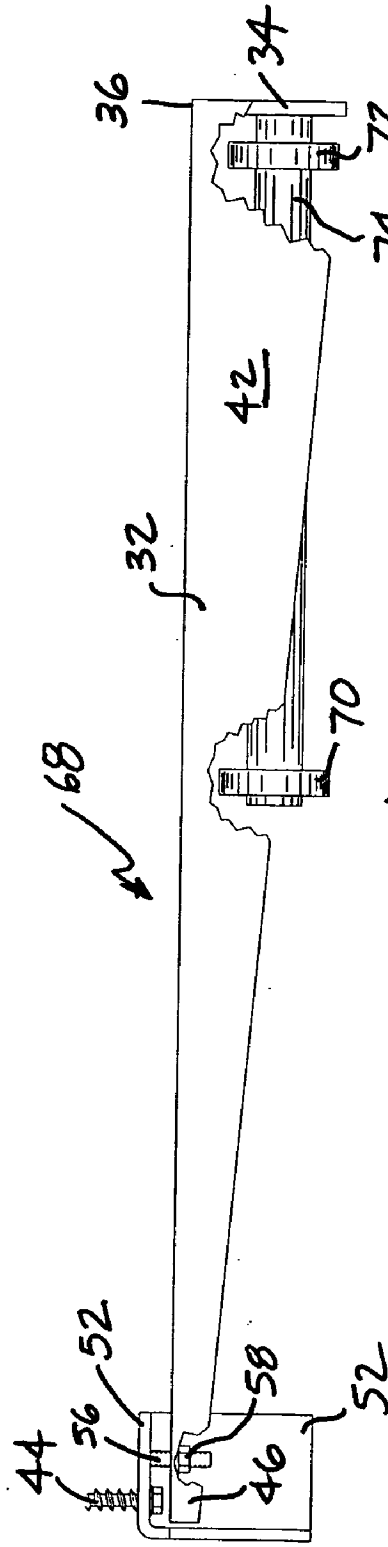

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FIG. 12

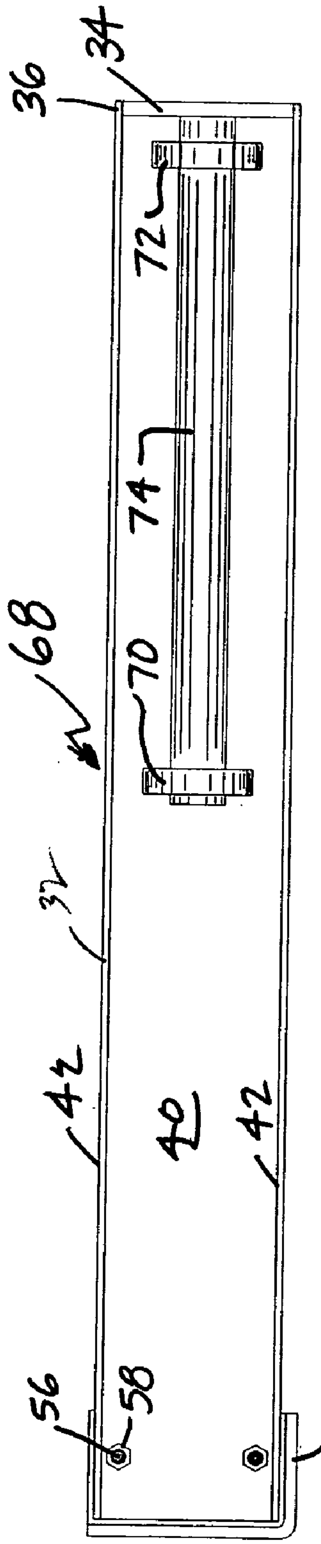
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FIG. 13

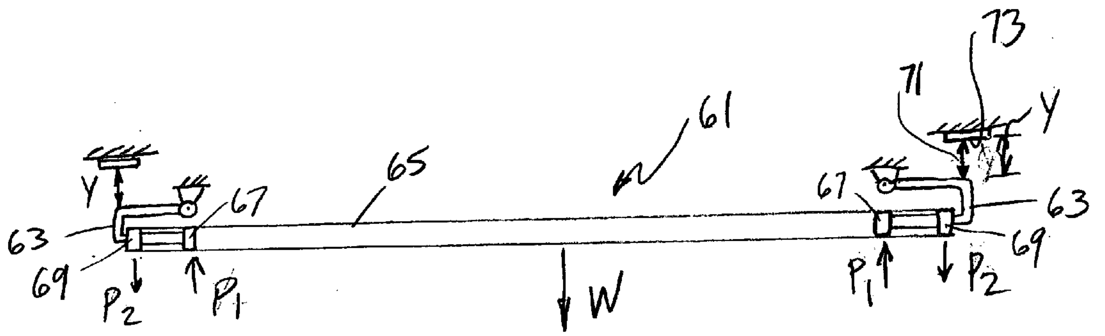

FIG. 14

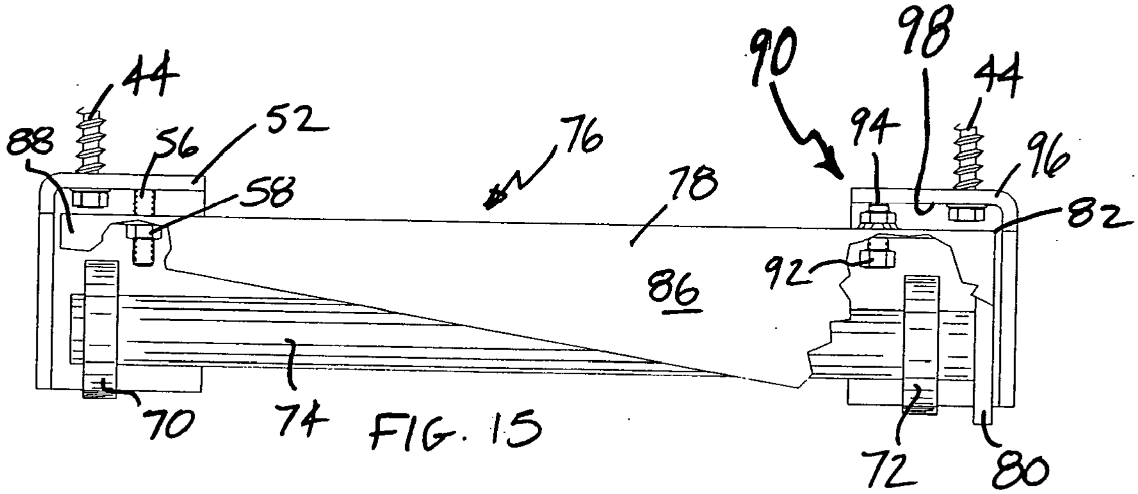
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FIG. 15

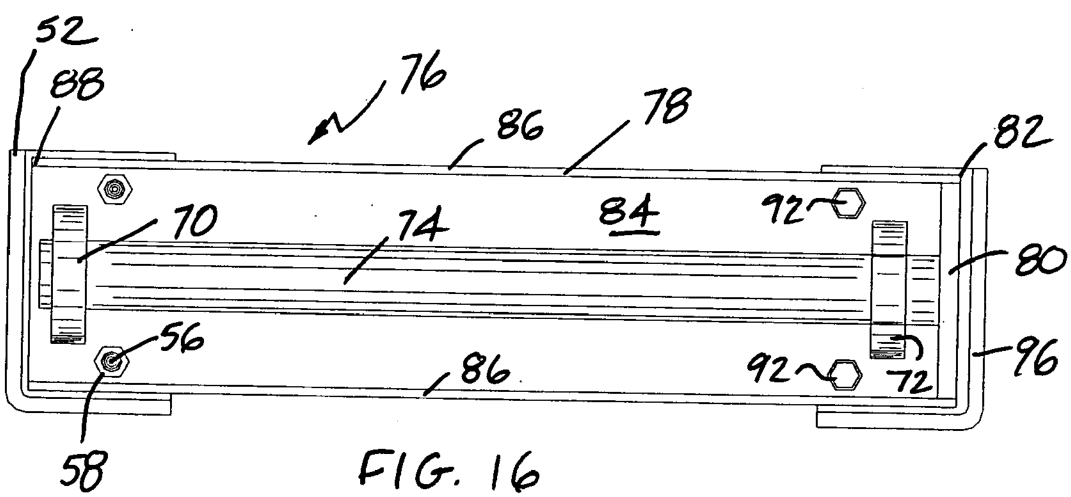
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FIG. 16

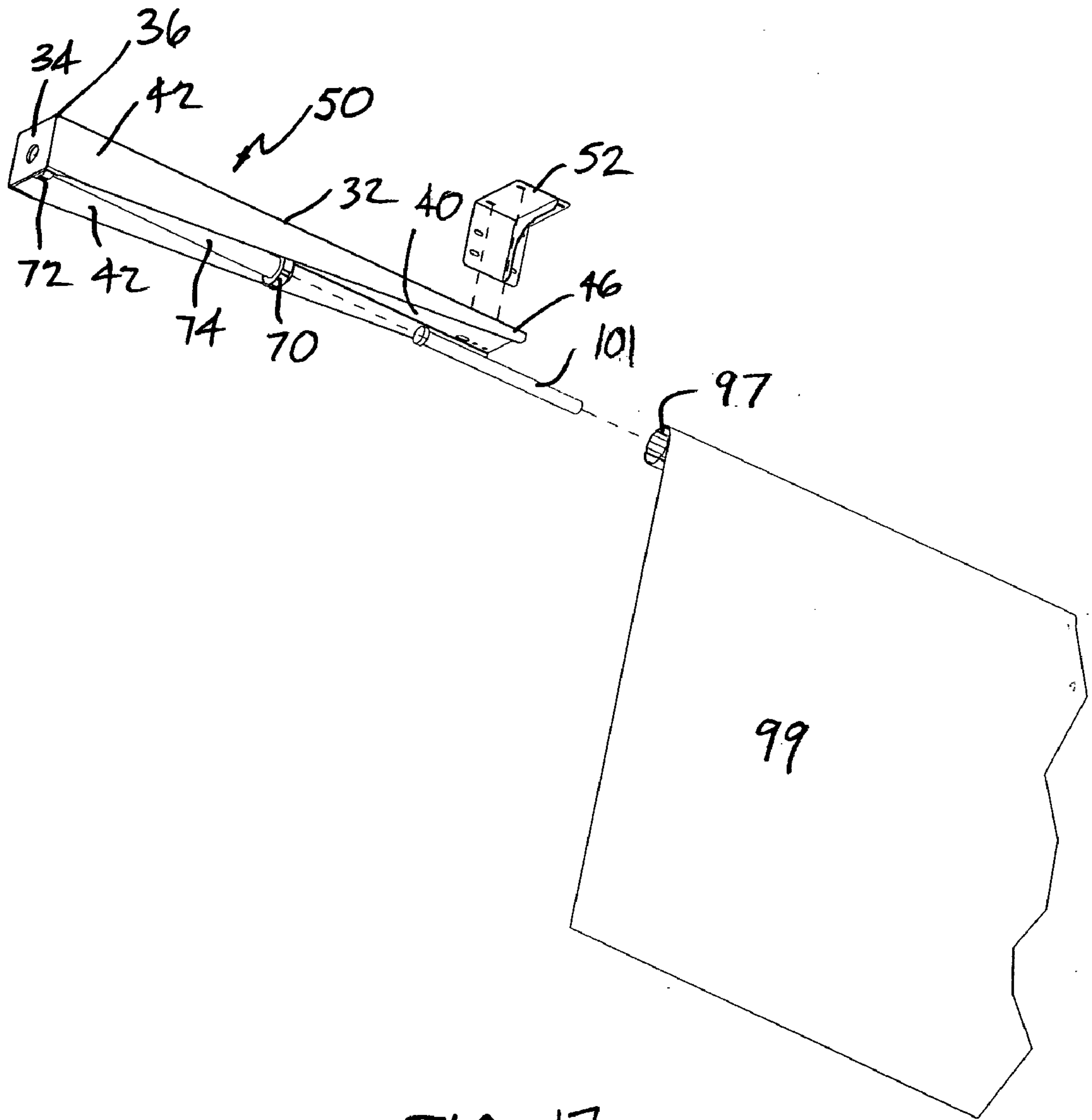

FIG. 17

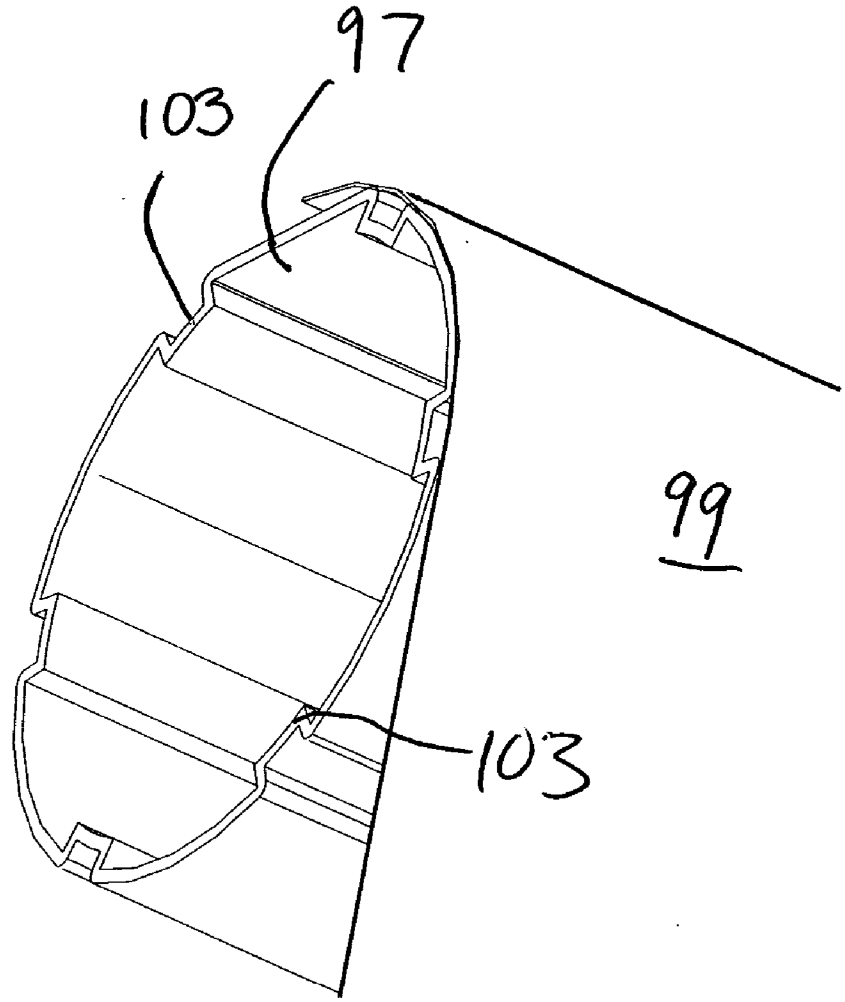

FIG. 17A

ROLLER SHADE MOUNTING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of co-pending U.S. patent application Ser. No. 10/338,066, filed Jan. 6, 2003.

FIELD OF THE INVENTION

[0002] The present invention relates generally to roller shades, and more particularly to a mounting system for supporting roller shades having long roller tubes.

BACKGROUND OF THE INVENTION

[0003] Roller shade systems having flexible shades supported by elongated roller tubes are well known. The roller tube, typically made from aluminum or steel, is rotatably supported to provide for winding receipt of the flexible shade on the roller tube. Roller shades include manual shades having spring driven roller tubes and motorized shades having drive motors engaging the roller tube to rotatingly drive the tube. The drive motors for motorized shades include externally mounted motors engaging an end of the roller tube and internal motors that are received within an interior defined by the tube.

[0004] Conventional roller shades have support systems that engage the opposite ends of the roller tube to provide the rotatable support that is required for winding and unwinding of the flexible shade. Referring to **FIG. 1**, for example, there is shown an end portion of a roller tube **2** that is rotatably supported in a conventional manner. The support system, shown schematically in **FIG. 1**, includes a drive end support assembly having a coupler **3** engaging the open end **4** of the tube **2** for rotation therewith. The coupler **3** is adapted to receive the drive shaft **6** of motor **5** such that rotation of the drive shaft is transferred to the coupler for rotation of the tube **2**. As shown, the motor **5** is secured to a bracket **7** for attachment of the roller shade to the wall or ceiling of a structure, for example. A coupler engaging an opposite end of the roller tube (not seen) could receive a motor drive shaft or, alternatively, could receive a rotatably supported shaft of an idler assembly. An example of a roller shade including an end supported tube is shown in U.S. patent application Ser. No. 10/039,818.

[0005] A roller shade tube supported in a conventional manner from the opposite ends will deflect in response to transverse loading, from the weight of an attached shade for example, substantially similar to a beam structure having support conditions known as "simple supports". A simply supported beam is vertically supported but is not restrained against rotation at the support locations. The response of a roller tube, supported at its ends in a conventional manner, to transverse loading is illustrated in **FIG. 2**. The distance, L, between the support points for the roller tube **8**, also known as effective length, is substantially equal to the overall length of the tube. Transverse loading applied to the end-supported roller tube **8**, from the weight, W, of a flexible shade **9** as well as from self-weight of the tube, results in a downward "sagging" deflection, d, in a central portion of the roller tube **8** with respect to the supported ends.

[0006] For roller shades having wider shades (e.g., widths of 15 to 30 feet or more), support of the correspondingly long roller tubes in a conventional manner can result in sagging deflection detrimental to the appearance of a supported shade. As illustrated in **FIG. 2**, V-shaped wrinkles, also known as "smiles", can be formed in an unrolled shade supported by a sagging roller tube. Sagging deflection in a conventionally supported roller tube can also have a detrimental effect on shade operation. During winding of a shade, the shade is drawn onto the tube in a direction that is substantially perpendicular to the axis of the tube. Due to curvature along the length of a sagging tube, opposite end portions of a supported shade will tend to track towards the center portion of the tube as the shade is rolled onto the tube. Such uneven tracking of opposite end portions of the shade can cause the end portions to be wound more tightly onto the end portions of the roller tube than the central portion of the roller tube. As a result, the central portion of the shade is not pulled tightly to the tube causing it to tend to buckle. This buckling of the central portion of the shade, if severe enough, can create variations in radial dimensions of the rolled shade along the length of the tube, thereby impairing subsequent rolling of lower portions of the shade.

[0007] Transverse deflection in a simply supported beam will vary depending on the effective length of the beam, the shape and dimensions of the beam cross section and the properties of the material from which the beam is made. For a simply supported beam having a point load, P, applied at the center, the transverse deflection at the beam center will be equal to $PL^3/48EI$, where E is the elastic modulus for the material and I is the modulus of inertia. The modulus of inertia, I, is a function of section geometry and is based on the second moment of area for the beam cross section taken about the centroidal axis. Since deflection increases exponentially (as the cube) with increasing tube length, it is understandable that excessive sagging deflection results when relatively long roller tubes are end-supported in a conventional manner.

[0008] The problem of sagging deflection in longer roller tubes has been addressed in prior art roller shades by increasing the diameter of the roller tube. Increase in tube diameter results in a shift of material to a greater distance from the tube centroidal axis such that the modulus of inertia, I, is increased. As shown by the above-discussed equation, sagging deflection in an end supported roller will decrease in direct proportion to increase in the moment of inertia, I. A known roller shade system with shades having a width of 20 feet, for example, includes a correspondingly long roller tube having a diameter of approximately 4¾ inches. Increasing the shade width to 25 feet required that the tube diameter be increased to 6¼ inches to prevent excessive sagging deflection in the roller tube. Increasing the shade width beyond 25 feet required that the roller tube diameter be increased to 8 inches or more.

[0009] Although increase of the roller tube diameter serves to reduce sagging deflection in conventional end-supported tubes, there are undesirable consequences associated with such a solution. Increasing the diameter of the roller tube increases weight, thereby potentially affecting the size and type of structure capable of providing rotatable support for the tube. Also, additional space required by the larger diameter roller tube and its associated support structure may not be readily available in many installations.

SUMMARY OF THE INVENTION

[0010] The present invention provides a mounting system including a pair of assemblies for mounting a shade roller having a roller tube. According to a first embodiment, each assembly includes a bearing that is receivable within an interior defined by the roller tube and adapted for engagement therewith to define a support point for rotatably supporting the tube. The support points of the assemblies define an unsupported central tube portion therebetween. Each assembly further includes a bearing support member having opposite first and second ends, the bearing being connected to the support member adjacent the first end. The bearing support member is receivable within the tube interior to position the bearing at a sufficient distance from one of opposite ends of the tube to reduce the length of the unsupported central tube portion such that sagging deflection of the roller tube is limited.

[0011] Each assembly preferably includes an attachment member having first and second ends. The first end of the attachment member is connected to the bearing support member such that the bearing support member extends adjacent at least a portion of the attachment member. The second end of the attachment member is adapted for operably connecting the attachment member to the structure. The attachment member includes an end plate at the first end of the attachment member secured to an end of the bearing support member. The attachment member further includes a top wall secured to the end plate and side walls secured to opposite sides of the top wall. The top and side walls of the attachment member extend substantially parallel to the bearing support member.

[0012] According to a second embodiment, each assembly includes first and second bearings that are receivable within an interior defined by the roller shade tube and adpted to engage the tube for rotatably supporting the tube. The assembly further includes an elongated bearing support member supporting the first and second bearings for engagement with the roller shade tube at spaced locations in an end portion of the tube. The assembly preferably includes an elongated attachment member having opposite first and second ends. The attachment member is connected to the bearing support member at the first end and is adapted at the second end for connecting the attachement member to a structure.

[0013] The assembly preferably also includes a deflection adjustment mechanism including a separating member operably engaging the attachment member and a fixed support member to establish a set deflection of the attachment member. The deflection of the attachment member causes the first and second bearings to apply a reaction moment to one of the end portions of the roller shade tube. The separating member is adjustable to provide for variation of the set deflection and the corresponding reaction moment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] **FIG. 1** is a partial side elevational view, partly in section, schematically illustrating support of a roller shade tube at an end in a conventional manner;

[0015] **FIG. 2** is a side elevational view of a shade roller having a roller tube supported in a conventional manner at opposite ends;

[0016] **FIG. 3** is a schematic side elevational view illustrating a shade roller having a roller tube supported by a mounting system according to a first embodiment of the invention;

[0017] **FIGS. 4A-4D** are side elevational views comparing boundary support conditions and deflection profiles for a simply supported beam having end supports and a simply supported beam having inwardly shifted supports according to the mounting system of **FIG. 3**;

[0018] **FIG. 5** is a side elevational view of a preferred mounting assembly according to the mounting system shown in **FIG. 3**;

[0019] **FIG. 5A** is a sectional view taken along the lines **5A-5A** in **FIG. 5**;

[0020] **FIG. 6** is a sectional view taken along the lines **6-6** in **FIG. 5A**;

[0021] **FIGS. 7-9** are detail views showing alternative means of connecting the mounting assembly of **FIGS. 5-6** to the ceiling of a structure;

[0022] **FIG. 10** is a schematic side elevational view illustrating a shade roller having a roller tube supported by a mounting system according to a second embodiment of the invention;

[0023] **FIG. 11** is an enlarged detail view of a portion of the right hand side assembly of **FIG. 10**;

[0024] **FIG. 12** is a side elevational view of a preferred mounting assembly according to the mounting system shown in **FIG. 10**;

[0025] **FIG. 13** is a bottom view of the mounting assembly shown in **FIG. 12**;

[0026] **FIG. 14** is a schematic side elevational view illustrating a shade roller having a roller tube supported by a mounting system according to a third embodiment of the invention;

[0027] **FIG. 15** is a side elevational view of a preferred mounting assembly according to the mounting system shown in **FIG. 14**;

[0028] **FIG. 16** is a bottom view of the mounting assembly shown in **FIG. 15**;

[0029] **FIG. 17** is an exploded perspective view of a motorized shade roller incorporating a mounting system according to the present invention; and

[0030] **FIG. 17A** is an enlarged detail of the end of the roller tube of **FIG. 17**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0031] The present invention provides a system for mounting a roller shade to a structure with limited or controlled deflection resulting in the roller shade tube. Limitation or control of roller tube deflection is particularly desirable in roller shades having wide shades and correspondingly long roller tubes, which are susceptible to sagging deflections. As used herein, the term "sagging deflection" refers to deflection of a central portion of the roller tube relative to the opposite ends. Sagging deflection, therefore, could involve deflections at the tube ends as well as in the central portion, depending on the support conditions for the roller tube. As will be described in greater detail, the mounting systems according to the present invention limit or control sagging deflection in the central portion of a roller shade tube. In contrast to prior roller shade systems, the present invention addresses sagging deflection by modifying the support conditions for the shade roller tube instead of by increasing tube diameter.

[**0032**] Referring to **FIG. 3**, a shade roller mounting system **10** according to a first embodiment of the present invention is illustrated schematically. The mounting system **10** includes first and second assemblies **11** each adapted to engage one of opposite end portions of a shade roller tube **12**. The assembly **11** includes a bearing **13** that is adapted to engage the roller tube **12** for rotatable support of the tube. As shown, a portion of the assembly **11** is receivable within an interior defined by the roller tube **12** to position the bearing at a distance, x, from one of the ends of the tube. The assembly **11** is further adapted for connection to a ceiling of a structure, as illustrated, for securing the roller shade to the structure. The assembly **11** could, alternatively, be secured to a wall of the structure.

[**0033**] The distance x, which represents the distance by which the support points for roller tube **12** have been inwardly shifted, represents a significant portion of the overall length of the roller tube. In the system shown in **FIG. 3**, the distance x equals approximately ⅕ of the overall length of the tube **12**. The invention, however, is not limited to any particular ratio between the distance x and the overall tube length. The inward shift of the support locations provided by the mounting system **10** is sufficient to limit sagging deflection in the central portion of the tube **12** in comparison to a similar roller tube supported in a conventional manner at the ends of the tube.

[**0034**] Referring to **FIGS. 4A-4D**, the manner in which the support conditions for a roller shade tube are modified by mounting system **10**, and the resulting effect on sagging deflection, is illustrated. Referring first to **FIG. 4A**, there is shown a beam structure simply supported at opposite ends and having an overall length, L_1. As discussed previously, a roller tube supported in a conventional manner at the opposite ends will deflect in a substantially equivalent manner as the simply supported beam shown in **FIG. 4A**. Under an evenly distributed loading as shown, such as would be applied to a roller tube from the weight of a supported shade, the equivalent beam structure will have a deflected profile shown in **FIG. 4B** and a sagging deflection d_1.

[**0035**] Referring to **FIG. 4C**, the beam structure shown in **FIG. 4A** modified to incorporate support conditions according to the mounting system **10** is shown. Accordingly, each of the supports has been inwardly shifted from one of the ends by a distance, x. As a result, the effective length of the unsupported central portion of the beam has been reduced to L_2. Deflection in the central portion of the beam, which varies in proportion to the cube of effective length as discussed above, is thereby reduced in comparison to the deflection of the end-supported beam shown in **FIG. 4B**. Because of the inward shift of the support points, the opposite end portions of the beam of **FIG. 4C** extend outwardly and unsupportedly from the support points. Extending in this outward manner from the support points, the end portions function like cantilevers in counterbalancing relation to the central portion between the supports further reducing the sagging deflection.

[**0036**] The beam of **FIG. 4C** having modified support conditions according to mounting system **10**, will have a deflected profile and sagging deflection, d_2, as shown in **FIG. 4D**. With respect to the support location, the beam deflects downwardly in a central portion and upwardly in the opposite end portions. The deflections, however, will be additive for the sagging deflection d_2, which as discussed above, represents the relative deflection between the center and the opposite ends. As an example, a shade roller including a 30 foot long tube and having a diameter of 5.5 inches was supported in the conventional manner at the opposite ends of the tube. The sagging deflection, d_1, for the shade roller tube was equal to approximately 0.7 inches. The same shade roller was then supported by mounting system **10** such that each of the supports was inwardly shifted by a distance x equal to 5 feet. As a result, sagging deflection was reduced by more than 90 percent to approximately 0.06 inches.

[**0037**] Referring to **FIGS. 5-7**, a preferred mounting assembly **18** constructed in accordance with the mounting system **10** of **FIG. 3** is shown. The mounting assembly **18**, one of a pair of assemblies engageable with opposite end portions of a roller tube, includes a bearing **20** supported adjacent a first end of an elongated bearing support shaft **22**. The mounting assembly **18** further includes an attachment member **32** for connecting the bearing support shaft **22** to a fixed support member of a structure, such as a wall or ceiling of a facility for example. The attachment member **32** includes an end plate **34** at a first end **36** of the attachment member **32**. The end plate **34** of the attachment member **32** is secured to a second end **38** of the bearing support shaft **22**, preferably by welding. The attachment member **32** further includes a top wall **40** and a pair of side walls **42** that are located on opposite sides of the bearing support shaft **22**. As shown in the sectional view of **FIG. 5A**, the top wall **40** and side walls **42** form a U-shaped portion that is secured to the end plate **34** to extend adjacent the elongated bearing support shaft **22** substantially parallel thereto. Screws **44** are received by the top wall **40** of the attachment member **32** adjacent a second end **46** to secure the attachment member to a ceiling **48** of a structure.

[**0038**] Each of the side walls **42** of the attachment member **32** tapers between the first end **36** of the attachment member **32** and the second end **46** such that the height of the side walls **42** is minimum at the second end **46**. The tapering of the side walls **42** in this manner reduces the weight of the assembly **18**. The tapering of the side walls **42** also provides access to the top wall **40** at the second end **46** to facilitate placement of the screws **44** for securing the attachment member **32** to the ceiling **48**. The attachment member **32** and the bearing support shaft **22** are substantially equal in length. This construction provides for positioning the bearing **20**, as shown in **FIGS. 3 and 6**, adjacent the connection between the attachment member **32** and the ceiling **48**.

[**0039**] Referring to **FIGS. 8 and 9**, alternative means of connecting the attachment member **32** to the ceiling **48** of a structure are shown. In **FIG. 8**, a mounting assembly **50** includes a mounting bracket **52** for connecting attachment member **32** to a structure. The mounting bracket **52** is adapted to receive threaded fasteners **54** for mounting the bracket **52** to ceiling **48**. Threaded shafts **56** extend downwardly from the bracket **52** and are received by the attachment member **32** adjacent the second end **46**. Threaded nuts **58** engage the shafts **56** to provide for support of the attachment member **32** by the bracket **52**. Referring to **FIG. 9**, shade roller mounting assembly **60** includes a hinge member **62** having first and second portions **64, 66** pivotably connected to each other. The first and second portions **64, 66** of the hinge member **62** are respectively secured to the mounting bracket **52** and to the attachment member **32** to facilitate pivoting between the attachment member **32** and the structure.

[**0040**] Each of the above-identified assemblies constructed according to shade mounting system **10** included a single bearing **20** engaging the roller tube. Referring to **FIGS. 10 and 11**, there is illustrated a shade mounting system **51** according to a second embodiment of the invention. The shade mounting system **51** includes mounting assemblies **53** engaging opposite end portions of a roller tube **55**. The assembly **53** includes first and second bearings **57, 59** each adapted to engage the roller tube **55** for rotatably supporting the tube. Similar to the mounting assemblies of mounting system **10**, a portion of the assembly **53** supporting the bearings **57, 59** is receivable within an interior defined by the roller tube **55**. In contrast to mounting system **10**, however, in which a single bearing defines an inwardly shifted support point, the engagement between the pair of bearings **57, 59** and the roller tube **55** results in oppositely directed reaction forces of W and 1/2W at the location of bearings **57, 59** respectively.

[**0041**] Referring to **FIG. 11** showing the right hand side assembly **53** of **FIG. 10**, the oppositely directed reaction forces create a force couple that results in application of a clockwise moment, M_R, to the tube end portion. In a similar fashion, the bearings of the left hand side assembly **53** create a force couple applying a counterclockwise moment. Rotation of the opposite end portions of roller tube **53** in response to application of the moments to the opposite the moments M_R drives the center portion of the roller tube **55** upwardly thereby reducing or eliminating sagging deflection.

[**0042**] Referring to **FIGS. 12 and 13**, a preferred mounting assembly **68** in accordance with the mounting system **51** of **FIGS. 10 and 11** is shown. The mounting assembly **68** includes first and second bearings **70, 72** rotatably supported by a bearing support shaft **74**. The bearings **70, 72** are located adjacent opposite ends of the shaft **74** to position the first bearing **70** inwardly from an end of a roller tube and the second bearing **72** adjacent the end of the roller tube, as seen in **FIG. 10**. The bearing support shaft **74** is secured to an attachment member **32** that is, in turn, secured to a mounting bracket **52** in a similar fashion to the attachment member **32** of assembly **50** of mounting system **10** for connection between the attachment member and a structure.

[**0043**] Referring to **FIG. 14 a** mounting system **61** according to a third embodiment of the invention is shown. The mounting system **61** includes mounting assemblies **63** engaging opposite end portions of a roller tube **65**. Similar to the assembly **53** of mounting system **51**, the assembly **63** includes first and second bearings **67, 69** each adapted to engage the roller tube **65** for rotatably supporting the tube. Also similarly to assembly **53**, the portion of assembly **63** that supports the bearings **67, 69** is receivable within an interior defined by the roller tube **65**.

[**0044**] In mounting system **51**, the magnitude of the moments M_R applied to the end portions of the tube **55** is determined by the weight W that is applied to the roller tube. In contrast, mounting system **61** includes adjustment mechanisms **71** that provide for variable control of the force couple that is applied to the roller tube by the bearings **67, 69**. The adjustment mechanism **71** engages the assembly **63** and a fixed bearing surface **73** to maintain a set separating distance, y, between the assembly **63** and the fixed bearing surface **73**. The deflection of the assembly **63** established by the adjustment mechanism **71** pivots the assembly **63** with respect to the structure to which the assembly is connected. The pivoting of assembly **63** causes a corresponding pivoting of the bearings **67, 69**, supported by the assembly, which determines the magnitude of forces P_1 and P_2 of the force couple and the resulting magnitude of the moment that is applied at the roller tube end portion. Variation in the separating distance y by adjusting mechanism **71** results in variation in the deflection of assembly **63** and a corresponding change in the moments applied to the roller tube.

[**0045**] Referring to **FIGS. 15 and 16**, a preferred mounting assembly **76** according to mounting system **61** is shown. The mounting assembly **76** includes first and second bearings **70, 72** that are rotatably supported by a bearing support shaft **74**. The bearing support shaft **74** is secured to an end plate **80** of an attachment member **78** located at a first end **82** of the attachment member **78**. The attachment member **78** includes a top wall **84** and opposite side walls **86** extending between the first end **82** and an opposite second end **88** substantially parallel to the bearing support shaft **74**. The bearing support shaft **74** and attachment member **78** are substantially equal in length. The attachment member **78** is secured to a mounting bracket **52** for connection of the assembly to the ceiling of a structure adjacent the first bearing **70**.

[**0046**] An adjustment mechanism **90** includes a threaded adjustment member **92** engaging the attachment member **78** adjacent the first end **82** such that a terminal end **94** of the adjustment member **92** extends to a distance from the attachment member **78**. A bracket **96** securable to the ceiling of a structure defines a fixed bearing surface **98** adapted for contact by the terminal end **94** of the threaded adjustment member **92** such that a set separation is maintained between the first end **82** of the attachment member **78** and the fixed bearing surface **98**. As described above, the deflection of the first end **82** of the attachment member **78** determines the magnitude of forces P_1 and P_2 of the force couple and the resulting moment applied to the roller tube end. Threaded engagement between the threaded adjustment member **92** and the attachment member **78** provides for variation in the distance that the terminal end **94** extends from the adjustment member **78** and a corresponding variation in the set separation between the attachment member **78** and the fixed bearing surface **98**. Such variation in the separation that is provided by the threaded engagement of the adjustment member **92** provides for adjustment of the moment applied at the end of the roller tube.

[**0047**] As described previously, motorized shade rollers include drive motors for rotating the roller tube to wind and unwind a supported shade. Referring to **FIG. 17**, there is shown an exploded view of a motorized shade roller incorporating mounting assembly **50** of **FIG. 8**. The shade roller includes a roller tube **97** supporting a flexible shade **99**. As shown in **FIG. 17A**, the wall of the roller tube **97** is formed to include longitudinal indentations **103** extending inwardly with respect to the interior of the roller tube. The indentations **103** are adapted for interfit with corresponding formations on the outer periphery of the bearings **70**, **72** to facilitate engagement therebetween. The shade roller further includes a drive motor **101** that is receivable within the interior defined by roller tube **97** and engages roller **70** for rotating roller tube **97**.

[**0048**] In the above discussion, the effect provided by modification of the boundary support conditions from the conventional end-supported roller tubes has focused on reducing the sagging deflection of long roller tubes. It should be understood, however, that application of the present invention is not limited to reduction of sagging deflection and could be used to provide for upward deflection of the central portion of the roller tube with respect to the opposite end portions.

[**0049**] As discussed above, the modified boundary support conditions provided by the present invention have application to shade systems having wide shades and correspondingly long roller tubes. The present invention provides for limitation or control of sagging deflections in long roller tubes without requiring increase in the diameter of the roller tubes. The present invention, however, is not limited in application to long roller tubes and has potential application for shorter roller tubes to provide for reduction of the diameter of such tubes without resulting sagging deflections that would otherwise occur were the reduced diameter roller tube to be supported in the conventional manner as a beam simply-supported at its opposite ends.

[**0050**] The foregoing describes the invention in terms of embodiments foreseen by the inventor for which an enabling description was available, notwithstanding that insubstantial modifications of the invention, not presently foreseen, may nonetheless represent equivalents thereto.

What is claimed is:

1. A system for mounting a shade roller including a roller tube having opposite ends, the mounting system comprising:

a bearing receivable within an interior defined by an end portion of the roller tube and adapted for engagement therewith to define a support point for rotatably supporting the tube, the support point defining one end of an unsupported length of the roller tube that includes a central portion of the tube; and

an elongated bearing support member having opposite first and second ends and receivable within the roller tube end portion, the bearing connected to the bearing support member adjacent the first end of the bearing support member, the bearing support member receivable within the tube interior to position the bearing at a distance from each of the opposite ends of the roller tube, the distance between the bearing and each of the opposite ends of the roller tube being greater than or equal to about one-sixth of an overall length of the roller tube so as to be sufficient to reduce the unsupported length of the roller tube such that sagging deflection of the roller tube is limited.

2. The mounting system according to claim 1 comprising a pair of bearing support members each supporting a bearing.

3. The mounting system according to claim 1 further comprising an end plate secured to the second end of the bearing support member and an elongated attachment member having opposite first and second ends, the first end of the attachment member connected to the end plate to extend longitudinally with respect to the roller tube and adapted for attachment to a fixed support member.

4. A system for rotatably supporting a roller tube having opposite ends, the system including a pair of mounting assemblies each comprising:

first and second bearings receivable within an interior defined by an end portion the roller tube and adapted to engage the tube for rotatably supporting the tube;

an elongated bearing support member supporting the first and second bearings for engagement with the roller tube at spaced locations within the interior of the tube end portion; and

a tube end support assembly secured to the bearing support member and attachable to a fixed support, the tube end support assembly adapted to pivot with respect to the fixed support in response to tube loading such that a moment is applied to the roller tube end portion to limit sagging of the roller tube.

5. The system according to claim 4, wherein the bearing support member of each mounting assembly has opposite first and second ends and wherein each tube end support assembly includes an end plate secured to the second end of the bearing support member and an elongated attachment member having opposite first and second ends, the first end of the attachment member connected to the end plate to extend longitudinally with respect to the roller tube, the tube end support assembly further including at least one mounting member for attaching the attachment member to the fixed support adjacent the second end of the attachment member, the at least one mounting member adapted to permit pivoting of the attachment member with respect to the fixed support.

6. The system according to claim 5, wherein the at least one mounting member for each mounting assembly includes a bracket adapted for attachment to the fixed structure by at least one threaded fastener, the attachment member pivotably connected to the bracket adjacent the second end of the attachment member.

7. A system for mounting a shade roller including a roller tube having opposite ends, the mounting system including a pair of assemblies each comprising:

at least one bearing receivable within an end portion of the roller tube to define a support point for rotatably supporting the tube;

a bearing support shaft having opposite first and second ends, the bearing support shaft adapted to rotatably support the bearing; and

an end support assembly secured to the bearing support shaft and attachable to a fixed support, the end support assembly adapted to pivot with respect to the fixed support in response to tube loading to apply a moment to the roller tube end portion that limits sagging deflection in the roller tube.

8. A system for mounting a shade roller including a roller tube having opposite ends, the mounting system comprising:

at least one bearing receivable within an interior defined by an end portion of the roller tube and adapted for engagement therewith to define a support point for rotatably supporting the tube, the support point defining one end of an unsupported length of the roller tube that includes a central portion of the tube; and

an elongated bearing support member having opposite first and second ends and receivable within the roller tube end portion, the at least one bearing connected to the bearing support member adjacent the first end of the bearing support member, the bearing support member receivable within the tube interior to position the bearing at a distance from each of the opposite ends of the roller tube, the distance between the bearing and each of the opposite ends of the roller tube being sufficient to reduce the unsupported length of the roller tube such that sagging deflection of the roller tube is limited to about ten percent or less of what the sagging deflection of the roller tube would have been if substantially the entire length of the roller tube was unsupported.

9. The mounting system according to claim 8 further comprising an end plate secured to the second end of the bearing support member and an elongated attachment member having opposite first and second ends, the first end of the attachment member connected to the end plate to extend longitudinally with respect to the roller tube and adapted for attachment to a fixed support member.

10. The mounting system according to claim 9, wherein the attachment member is secured to a shade mounting bracket adjacent the second end of the attachment member, the shade mounting bracket adapted for attachment to a fixed surface.

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