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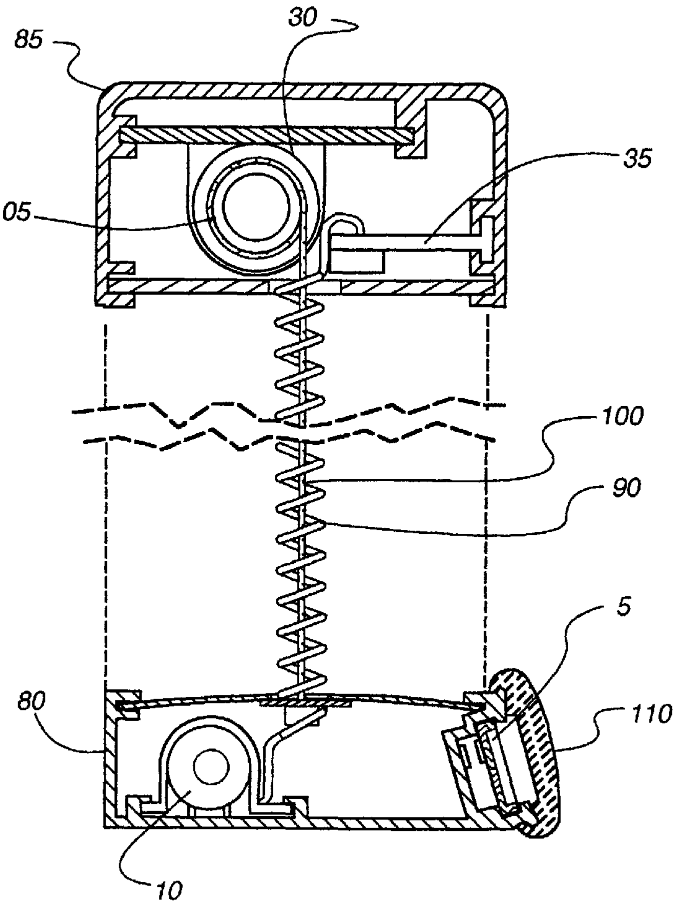
(54) Title: SOLAR POWERED MOTORIZED COVERING FOR AN ARCHITECTURAL OPENING



(57) Abstract: A covering for an architectural opening having an electric motor to retract the covering is described. The electric motor is powered by a photovoltaic cell array and a set of rechargeable batteries. The PC photovoltaic cell array is an integral component of the covering assembly and is arranged below the head rail (85) of the covering when the covering is in its extended position to maximize the amount of light incident on the photovoltaic cell array. The cellular shade with the location of the cells shown only by dashed lines having a head rail (85) and a bottom rail (80) secured thereto. The lift motor (30) and the control circuit (20) are located in head rail (85) while the associated battery pack (10) and PC array 5 are located in foot rail (80).

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Solar Powered Motorized Covering for an Architectural Opening

Background

Field of the Invention

The invention described herein relates to coverings for an architectural opening, more particularly electric motorized coverings incorporating solar cells to power a lift motor and to charge batteries associated with the motor.

Description of the Relevant Art

Various types of window coverings, for example, horizontal (Venetian) blinds, roll-up shades, pleated shades, Roman shades, honeycomb shades and vertical blinds, all have operating systems which differ according to their modes of operation. Traditionally, window covering of all types have been operated manually through the manipulation of cords and rods. Motorized systems for operating window coverings have also been developed, wherein the control to operate the opening may be located on the covering assembly itself or may be contained in a remote control device. Typically, these motorized window coverings are actuated by electric motors that are powered by batteries contained in the window covering assembly. It can be appreciated that the batteries must be periodically replaced or recharged. To this end, it is known to utilize photovoltaic cells (PC's) to provide auxiliary power to the motors and more importantly to recharge the batteries utilized in the motorized covering.

Many prior art window coverings incorporate the PC's into the head rail of the window covering wherein the PC's may be shaded for significant if not the majority of the daylight hours by window mullions, overhangs or adjacent structures, trees, or even the window frame itself. A shaded PC will not produce as much energy as one that is not shaded; accordingly, a larger PC array may be required to produce enough electrical power to both operate the motor and recharge the associated batteries when the PC array is placed on the head rail. PC's are expensive and relatively large PC arrays can significantly effect the cost of a solar-powered window covering assembly.

Several prior art systems have utilized a PC array that is separately attached to the window frame and has an electrical cord running to the window covering and the motor contained therein. With this type of system, the PC array can be placed lower on the window where it will receive more direct light but this arrangement is more difficult to install requiring two separate and distinct items to be attached to the window frame. Furthermore, if the PC is placed relatively low on the window, it may be visible when the window covering is retracted, thereby obstructing the view out of the window, as well as, being aesthetically displeasing.

U.S. Patent 4,807,686 of J. Schnebly teaches to place the PC array and the associated motor and batteries in either a foot rail or the head rail of a pleated shade, wherein the powered head rail or foot rail moves along a pair of opposed tracks that are mounted to either side of the window frame. The purpose of the Schnebly design was to provide a motorized window covering that could be utilized on non-vertical and curvilinear window surfaces, such as those that might be found in a greenhouse, or with a skylight, as well as, standard vertical windows. For use in a vertical window, the foot rail will typically be powered permitting it to move up the vertically mounted tracks, thereby retracting the pleaded shade. By mounting the PC array in the foot rail, the PC array is going to be incident to a greater amount of light than a similarly sized PC array that is mounted in a head rail. Unfortunately, the Schenbly design is not optimized for use on vertical surfaces, requiring the installation of not only the window covering itself but two opposed and parallel tracks as well. The parallel tracks must be installed with a relatively high degree of precision in order for the foot rail to move along the tracks properly, thereby increasing the cost of installation. Furthermore, when the window covering is in its retracted position, the tracks are exposed to view and may be aesthetically displeasing.

Prior art window coverings incorporating PC's typically utilize rechargeable nickel cadmium batteries to provide supplemental power to the motor during daylight operation of the window covering and to store PC generated electrical power for nighttime use of the window covering. Nickel Cadmium batteries suffer from "memory effect," wherein over time the batteries are only able to hold a charge similar to the amount they have been discharged during use. Since motorized window coverings are generally operated for a very short period of time between recharges, they are only slightly discharged, and after awhile the capacity of the batteries will be reduced to this level of discharge. Consequently, a window covering using nickel cadmium batteries may only be able to open and close once or twice before the memory-effected capacity of the batteries is reached. To avoid "memory effect" nickel cadmium batteries must be nearly fully discharged between rechargings on a regular basis; however, this does not occur in a motorized window covering that incorporates PC's since the PC's constantly recharges the batteries when light is present.

Summary of the Invention

A window covering having an electric motor to retract the covering is described. The electric motor is powered by a PC array and a set of rechargeable batteries. The PC array is an integral component of the window covering assembly and is arranged below the head rail of the covering when the covering is in its extended position to maximize the amount of light incident on the PC's.

In another embodiment, rechargeable alkaline manganese (RAM) batteries are specified for use in conjunction with amorphous PC's as the power supply for an electrical circuit that can be utilized in a variety of applications, such as the solar powered window coverings described herein. RAM batteries are more ideally suited to use in shallow cycle applications wherein the batteries are only discharged a few percent of their capacity between uses, such as the case with motorized window coverings, and RAM batteries, unlike Nickel Cadmium batteries, do not suffer from "memory effect." Amorphous PC's are preferable over crystalline PC's because they are capable of generating useful voltages at light levels significantly below those required by crystalline PC's. By combining the two and providing a Zener diode electrically coupled in parallel therewith an ideal circuit for use in shallow cycle applications is created.

In one embodiment, the batteries and motor are located in the head rail and a PC array hangs from the head rail by cords or cables when the window covering is in its extended position. When the window covering is retracted the PC array is configured to retract as well so they are not visible and do not obstruct the view from the window.

In another embodiment the motor is located in the head rail and the PC array is located in the foot rail. A wire extends from the head rail to the foot rail. In a honeycomb cellular variation, the wires pass inside each of the cells and are not externally exposed. The wires may be coiled to minimize unwanted bending of the wires when the window covering is retracted.

In yet another embodiment, the motor and batteries are contained within the foot rail and the PC's are mounted on the inside vertical surface of the foot rail facing the window. The motor is attached to a take-up cylinder to which one or more lift cords are attached. As the lift cord, which is fixedly attached to the head rail at a top end, is wrapped around the take-up cylinder, the foot rail is pulled upwardly toward the retracted position. The PC's may be angled slightly upwardly on the face of the foot rail to increase the amount of light incident on them. One variation of this embodiment includes a foot rail designed to accept slide in PC arrays and snap in control circuits and battery holders, wherein the connections also electrically couple the components together via a conductive copper foil conductive bus on the foot rail.

Other aspects, features and details of the present invention can be more completely understood by reference to the following detailed description of a preferred embodiment, taken in conjunction with the drawings, and from the appended claims.

Brief Description of the Drawings

Figure 1 is a generalized circuit diagram for a remote controlled PC powered window covering.

Figure 2 illustrates a PC powered window covering mounted in a window opening.

Figure 3 is an isometric of a honeycomb style window shade with parts removed. illustrating the internally routed electrical wires.

Figure 4 is an isometric of a roman style window shade illustrating electrical wires routed through the hems of the shade fabric.

Figure 5 is a fragmentary vertical section of a cellular shade illustrating the routing of coiled electrical wires through the interior of the cells.

Figure 6 is a fragmentary vertical section of the foot rail of a honeycomb cellular shade illustrating the snap fit connections of several components of the motorized lift system.

Figure 7 is a fragmentary section taken along lines 13-13 of Figure 12 illustrating the electrical connection of the snap in component to a copper foil bus of the foot rail.

Figure 8 is a diagrammatic isometric illustration of a cellular shade with a infrared control system permitting operation when a foot rail sensor is obstructed.

Figure 9 is a vertical section taken along line 21-21 of Figure 20 illustrating the infrared control system.

Figure 10 is a vertical section of a roll-up style shade mounted in a window opening, wherein the shade is partially retracted.

Figure 10A is a close-up of the interconnection between a lift cord associated with the roll-up shade and a suspension cord associated with the PC array as depicted in Figure 10.

Figure 11 is an isometric view of the roll-up shade of Figure 10.

Figure 12 is an isometric of a roll-up shade, wherein the PC array is mounted on the foot rail of the shade and the wires are slideably connected to guide cords of the roll-up shade.

Figure 12A is a enlarged isometric illustrating the connection between the lift cord and the electric cord of Figure 12.

Figure 13 is a vertical section through a roll-up shade wherein the PC array hangs from the head rail, and a catch is provided in the foot rail to retract the PC array when the shade is rolled up.

Figure 14 is a vertical section of a cellular style roll-up shade wherein the electrical wires are routed through the inside of the cells.

Figure 15 is a fragmentary horizontal section of a roller of a roll-up shade as depicted in Figure 14 illustrating the routing of the electrical wires to the motor located in the roller.

Figure 16 is sectional view of a pendant switch containing batteries and a PC array.

Figure 17 is a section of the pendant switch taken along lines 17-17 of Figure 16.

Figure 18 is a plan view of a bracket for a roll-up shade for use with the pendant switch of Figure 16.

Figure 19 is a section taken through line 19-19 of Figure 18 illustrating the connection of the pendant to the bracket.

Figure 20 is a fragmentary section taken through line 20-20 of Figure 18 illustrating the connection of a roller of a roll-up shade to the bracket.

Detailed Description

Various embodiments of a window covering incorporating a solar-powered motorized lift system are described. Although the invention is described herein in terms of a window covering, it is to be appreciated that embodiments of the invention may be utilized in conjunction with other types of architectural openings. Furthermore, the power supply circuit described herein is not limited to use in an architectural covering and may be utilized in a variety of applications were a self contained power supply that does not suffer from memory effect and does not require control circuitry beyond a simple Zener diode is desired.

Generally, a PC array is utilized to power the lift motor and recharge a set of one or more batteries. The PC array is located in a position below the head rail of the window covering, at least when the covering is extended across the window, to avoid being shaded by obstructions associated with the top of a window frame and improve the electrical output of the PC array. Furthermore, the PC array is integrated into the window covering assembly and does not have to be separately mounted to the window frame, thereby facilitating ease of installation. Finally, the PC array retracts with the window covering when the covering is raised so that the PC array is hidden from view and does not obstruct vision through the window.

Figure 1 shows a basic lift circuit 1 for a window covering in accordance with various embodiments the present invention. An amorphous PC array 5, which comprises one or more PC's, is electrically connected to a RAM battery pack 10. Amorphous PC's are capable of producing useful voltages in both direct and indirect sunlight albeit at low levels of current output. As the amount of light incident on the amorphous PC's increases, so does their output voltage. Accordingly, the voltage level of an amorphous PC array configured to produce charging voltages at low light levels will generally produce voltages significantly in excess of the voltage rating of the battery pack when exposed to higher light levels such as direct sunlight. Conversely, the voltages produced at lower light levels by each crystalline PC in a crystalline PC array is very small and a crystalline PC array typically cannot provide a sufficient charging voltage for a typical battery pack 10 unless a relatively large and consequently expensive crystalline PC array is utilized. For example, depending on the application, a crystalline PC array capable of producing sufficient charging voltage at the same low light levels as an amorphous PC array might require ten times as many PC cells. Another advantage of amorphous PC's over crystalline PC's is that they are typically much less expensive. Amorphous PC's suffer from an output degradation of approximately 20% over time; therefore, the PC array must be sized for a given application accordingly.

The battery pack 10 comprises one or more RAM cells that are connected in series and/or parallel with each other depending on the voltage level desired to operate the basic lift circuit 1. Unlike nickel cadmium cells that have been used in prior art applications and nickel metal hydride cells, RAM batteries do not exhibit "memory effect." "Memory effect" is a condition that occurs when a battery is charged to the same level several times consecutively. The battery develops a chemical "memory" of that level and will not allow a charging past that point. Although some of the capacity of a RAM battery may be lost over successive recharging cycles, the battery will retrain a capacity that is significantly greater than the amount that the RAM battery has been typically discharged. It is to be appreciated that the useful life of a rechargeable RAM battery is directly related to the extent to which it is discharged. For instance, a typical RAM battery has a discharge/recharge cycle life of around 20 if discharged to 75% of its capacity; whereas, a typical RAM battery will have a life of approximately 20,000 cycles if discharged to under 1% of its capacity. Raising or lowering of a typical window covering requires only a very small percentage of the capacity available from a RAM battery pack 10. Since RAM batteries in the battery pack 10 do not exhibit "memory effect," additional capacity is available between recharging cycles to raise or lower the blinds multiple times if required. Testing has indicated that after about 15,000 1%

cycles RAM batteries retain around 75% of their original capacity. It is to be appreciated that to overcome the memory effect problem when using nickel cadmium and nickel metal hydride batteries, it is known to associate circuitry with the batteries that control the batteries charging behavior to prevent shallow cycle recharges. These types of batteries are often referred to as "smart batteries." Although this solution solves the "memory effect" problem, smart batteries incorporating the necessary circuitry are extremely expensive when compared to low cost RAM batteries.

RAM batteries are susceptible to damage from excessive charging voltages such as those that might be produced by the PC array 5 when exposed to direct sunlight. Accordingly, a Zener diode 15, or a functional equivalent, is provided to limit the voltage input into the RAM battery pack 10 to below 1.65 volts per RAM battery wired in series. Zener diodes having a 2% variation tolerance are preferred. In a battery back having 8 RAM batteries in series a 1N4743C Zener diode is preferred having a 13 volt rating and a 1 watt capacity. In a battery pack having 4 RAM batteries in series, a 1N4736C Zener diode is preferred having a 6.8 volt rating and a 1 watt capacity. Voltage regulating circuitry can be used in place of the Zener diode in alternative embodiments. It is contemplated that in alternative embodiments other types of rechargeable batteries may be utilized in the battery pack 10, especially rechargeable batteries that do not suffer from a "memory effect", wherein such alternative battery types may or may not require the use of a Zener diode 15 to control the current flow of the PC array 5.

A control circuit 20 is provided which routes electrical current from the battery pack 10 or the PC array 5 to a motor 30 in the proper direction depending on whether the window covering is being lifted or lowered by reversing the direction of current flow. Signals to raise or lower the window covering are transmitted from a remote control to an infrared or radio receiver (not shown) that is coupled to the control circuit. As can be appreciated, the motor 30 is mechanically coupled to a mechanism for raising or lowering the window covering. For example, an output shaft of the motor 30 may turn a capstan which winds up one or more lift cords, or it may rotate a roller which winds up a fabric shade, neither of which is shown. Additionally, a limit switch system 35 may be provided that turns off power to the motor 30 when the window covering has been fully extended or retracted. In certain alternative embodiments of the invention, the control circuit 20 may also be operated by one or more switches that are electrically coupled to the control circuit 20 in place of or in addition to the infrared or radio receiver 25.

Figure 2 illustrates generally the desirability of locating a PC array below the head rail 40 of the window covering. As shown, the head rail 40 is mounted to a header 45 spanning a window opening. The header 45 itself and the window framework 50 effectively block direct sunlight from impinging on the rear vertical surface 55 of the head rail 40 facing towards the window. Only incident light that has been reflected from other surfaces and has not been absorbed will hit the vertical surface 55. The intensity of the indirect sunlight incident on the vertical surface 55 is much less than that of direct sunlight and accordingly, a PC array located on the vertical surface 55 will produce less electricity than a PC array 5 located directly in front of the window pane(s) 65 that receives direct sunlight. It can be appreciated that even in the case of a north facing window that receives no direct sunlight, the intensity of the indirect light through the window will be greater on a PC array 5 located facing the window panes then one located on a head rail 40 behind the window framework 50. The PC array 50 shown herein is mounted on the foot rail 70 of a honeycomb cellular shade 75, although as will be shown below, a PC array 5 may be mounted in any number of ways on a variety of window coverings that cause it to be lowered below the upper framework 50 of a window when the covering is extended.

The solar powered lift system as described herein is incorporated by way of example in three types of window covering assemblies: a cellular shade, a roman shade, and a roll-up style shade. It is understood that this system may be adapted for retracting other types of window coverings, such as Venetian blinds and Silhouettes ™ produced by Hunter Douglas, the assignee of this application, as would be obvious to one of ordinary skill in the art with the benefit of this disclosure. Furthermore, this system maybe adapted for tilting the slats of a Venetian blind or a plantation shutter, wherein the motor 30 is coupled with a tilt mechanism.

Solar Powered Cellular and Roman Shades

Figure 3 illustrates a honeycomb cellular style shade incorporating a basic lift circuit 1. As shown, a PC array 5 is mounted on the vertical surface of the foot rail 80 that faces a window when installed. In this embodiment the lift motor is located in the head rail 85 and is attached to the PC array 5 by electrical wires 90 that are routed vertically through the inside of the honeycomb cells 95. Also routed through the inside of the honeycomb cells are a plurality of lift cords 100 that are fixedly attached to the foot rail 80 at a bottom end thereof and attached to one or more take-up spools 105 (as shown in Figure 5) in the head rail 85. The take-up spool(s) (or capstans) 105 are attached to a drive shaft of the lift motor 30. Actuation of the lift motor 30 causes the lifts cords 100 to wrap around the spools 105, thereby pulling the foot rail 80 upwardly. Each of the cells 95 collapse onto themselves and the shade is retracted. The electrical cords 90 can be routed through the cellular shades 95 adjacent to the lift cords 100, as shown, such that the electrical cords 90 are taken up onto the take-up spools 105 with the lift cords 100 or they can be separately routed, wherein they gather in the top cells 95 or within the head rail 85. It is appreciated that the battery pack 10 maybe located in either the head rail 85 or the foot rail 80 in variations of this embodiment. Additionally, an IR sensor 25 (not shown) is typically positioned along the front vertical surface of the head rail 85 to receive retract and extend commands from a remote control.

Figure 4 is a isometric view of a roman-style shade incorporating the basic lift circuit 1 in a manner similar to that described above for a cellular shade. As described above, a PC array 5 is mounted on the rear vertical surface of a foot rail 80 that faces a window when installed. Similar to the previous embodiment, the lift motor 30 is located in the head rail 85 and is attached to the PC array 5 by electrical wires 90 that extend vertically from the head rail 85 to the foot rail 80. In this embodiment, the wires are routed through the hems 96 of the shade 98.

Figure 5 is a sectional view through a cellular shade with the location of the cells shown only by dashed lines having a head rail 85 and a bottom rail 80 secured thereto. The lift motor 30 and the control circuit 20 are located in head rail 85 while the associated battery pack 10 and PC array 5 are located in foot rail 80. As shown, the PC array 5 is angled upwardly so that it faces at least partially in the direction of the sky when mounted in a window. Furthermore, a lens cover 110 is provided to both protect the PC array 5, as well as, focus the sunlight onto the PC array 5. The wires 90 that electrically connect the PC array 5 and the battery pack 10 with the motor 30 are routed vertically through the inside of the honeycomb cells 95 as described with reference to Figure 3. In this variation, however, the wires 90 are coiled in a manner similar to a telephone headset cord around at least one of the lift cords 100. The coiled wires 90 expand when the shade is lowered, and contract when the shade is retracted. In other variations the coiled wires 90 need not be coiled around the lift cords 100 and could be separately routed through the honeycomb cells 95. Furthermore, the coiled wires 90 could be utilized in any type of window covering wherein the foot rail 80 is retracted in the manner described and is therefore not limited to use with honeycomb cellular shades.

Figure 6 is a cross sectional view of a foot rail 80 for use with another embodiment of a solar powered cellular shade, wherein the entire basic lift circuit 1 is contained within the foot rail 80 of the shade assembly. As shown, the foot rail 80 and the components contained therein are configured for a snap fit assembly. Additionally, an electrical bus is provided that is comprised of metallic foil traces extending along the top inside surface of the foot rail 80, wherein electrical connection can be made with the bus by spring connectors when the various electrical components are snapped into place.

The foot rail 80 enclosure is comprised of upper and lower L-shaped pieces 115 and 120, which are press-fit together. The lower L-shaped piece 120 is typically fabricated from an extruded aluminum, which provides dimensional stability and stiffness, while the upper L-shaped piece 115 is typically fabricated from plastic, which is lightweight and non-conductive. A thin arcuate support slat 125 typically comprised of a plastic or aluminum material is slid or snapped into a pair of slots 126 provided along the upper surface of the upper L-shaped piece 115. A cellular shade 95 is glued or attached using any other suitable means to the arcuate support slat 125. The upper L-shaped piece 115 also comprises a left latch arm 130 and a right latch arm 135 that run the entire longitudinal length of the upper L-shaped piece 115 and are utilized to attach various components of the basic lift circuit 1 to the foot rail 80. As shown, a main circuit board 140 is shown snapped in place between the left and right arms. The main circuit board comprises the control circuit 20 and the battery pack 10 and a plurality of U-shaped metallic spring connectors 145. As shown in Figure 7, the U-shaped spring connectors 145 are fixedly connected to conductive traces on the main circuit board 140 via rivets, screws, solder interconnections or any other conductive means. The U-shaped connectors 145 are biased against foil traces that comprise the electrical bus 150.

The motor 30 is mounted to a plastic base that is also connected to the upper L-shaped piece 115 by the latch arms 130 and 135 in a similar manner as the main circuit board 140, although the plastic base and its associated spring connectors are not shown. Additionally, one or more limits switches 35 can be connected to the upper L-shaped piece 115 in a similar manner as the main circuit board 140. Although the battery pack 10 is shown in Figure 5 as being integral with the control circuit 20 on the main circuit board 140, it is to be understood that in alternative embodiments, the battery pack 10 can comprise a separate component to be snapped in place between the latch arms 130 and 135.

The electrical bus 150 as shown is comprised of four bus strips that are generally parallel to each other and run substantially the entire length of the foot rail 80. The bus strips are typically comprised of a thin copper foil that has been adhesively bonded to the inside surface of the L-shaped piece 115. Depending on the particular component being snapped into place, the u-shaped spring connectors 145 are positioned to make an electrical connection with the bus strip. The PC array 5 is attached to the rear vertical face of the upper L-shaped piece 115. As illustrated in Figure 5, it is slid into a slot formed in the upper L-shaped piece 115. The PC array 5 has a pair of spring connectors 155 coupled to it, similar to those described above and illustrated in Figure 7. Corresponding to the spring connectors 155, two parallel foil

155, two parallel foil strips 160 are affixed to the surface of the upper L-shaped piece 115 behind the PC array 5. When one or more PC arrays 5 are slid into the slots the spring connectors 155 are biased against the foil strips 160. As mentioned above, the foil strips 160 of the PC array 5 are connected to the electrical bus 150 by connector strips (not shown) that are installed at one end of the foot rail 80. A lens 110, which preferably runs the entire length of the foot rail 80, is provided to protect the PC array 5 and can be shaped to focus more sunlight onto the PC array 5. Additionally, a soft bumper 165 extends beyond the rear vertical face of the foot rail 80 to permit the foot rail 80 to occasionally impact a window pane during use without causing damage to the PC array 5 or the basic lift circuit 1 contained in the foot rail 80.

By (1) snapping all of the aforementioned components in place to connect them to the electrical bus 150, (2) attaching a infrared receiver 25 to the control circuit portion of the main circuit board 140 via connections pins, and (3) electrically connecting the PC array 5 with the electrical bus 150 via connector strips at one end of the foot rail 80, a basic lift circuit 1 is completed. It can be appreciated that this embodiment does not utilize any wires. Furthermore, since both the electrical bus 150 and the left and right latch arms 130 and 135 extend the entire length of the foot rail 80, the components can be snapped in anywhere along the foot rail 80 (except for the board associated with the circuit control which must be located proximate a hole in the lower L-shaped piece 120 provided for the IR receiver 25). It can be appreciated that the various components can then be located wherever necessary to ensure that the foot rail 80 is balanced (i.e. the battery pack 10 could be located at one end of the foot rail 80 to offset the weight of a motor 30 that is located at the other end of the foot rail 80.

Mounting an IR receiver 25 in the foot rail 80 in an embodiment such as the one described above relative to Figure 6 eliminates any need to run wires to the head rail 85 between a control circuit 20 and the receiver 25; however, the foot rail mounted IR receiver 25 can become obstructed when the window covering is lowered behind an object 185 such as a couch or a chair. By attaching an infrared reflector 170 to the head rail 85 and a corresponding reflector 175 to the foot rail 80 as illustrated in Figures 20 and 21, an IR sensor 25 can be operated by remote control 180 even when the sensor 25 is obstructed. A infrared reflector 170 is fixed to the inside surface of the head rail 85 with a reflective surface located directly above and angled downwardly approximately 45 degrees towards the IR receiver 25. Accordingly, when a user points the remote control 180 in the direction of the reflector 170 and activates the remote control, an IR signal will reflect off of the reflector 170 and be directed downwardly toward the IR receiver 25 on the foot rail 80. A second IR reflector 175 is affixed to the foot rail 80 just below the IR receiver 25, wherein the reflective surface is angled upwardly at an angle of approximately 45 degrees. Accordingly, the downwardly traveling IR signal is reflected back at the IR receiver 25 as shown in Figure 9.

Solar Powered Roll-up Shades

Figures 10 and 11 illustrate a first embodiment of a solar powered roll-up window shade assembly. A roller 200 is rotateably mounted in a head rail assembly 205 (mounting hardware not shown). The head rail assembly is configured to be fixedly attached to a window frame header. It is to be appreciated that some variations may comprise mounting brackets to which the roller is rotatably attached without the use of a head rail. However, for purposes of this disclosure and the appended claims a head rail comprises any structure that can be utilized to attach a window covering assembly to a window frame. A motor 30 is typically mounted to either end of the roller 200 or contained within a bore 210 of the roller 200 with the motor's shaft connected to the head rail 205. A fabric or plastic shade 215 is typically attached to the outside of the roller 200 such that it wraps around the roller as the shade is retracted. The fabric shade 215 also includes a small foot rail 220 that often comprises a wood, metal or plastic rod that receives the end of the shade 215 and provides weight to the shade to keep the shade 215 in place when extended. As shown in Figure 11, a pair of guide cords extend from the foot rail to the top of the shade 215 where they are connected with the roller 200. The battery pack 10 is generally located in either the bore 219 of the roller 200 or in the head rail 205. A PC array 5 is suspended below the top section of the window frame by suspension cords 230 from the head rail 205 between the shade 215 and the window pane. Electrical wires 235 extend from the PC array 5 to the head rail 205 wherein they are electrically coupled to the other components of the basic lift circuit 1. Each guide cord 225 is slidably coupled with a suspension cord 230 of the PC array 5 by connector 235. As illustrated in Figure 10a, the connector 235 includes a clamp portion 240 in which a suspension cord 230 is received. The other end of the connector 235 comprises a ring member 245 with a inside diameter significantly larger than the diameter of the guide cord 225 that passes therethrough. A corresponding stop member 250 is fixedly attached to each of the guide cords 225 at a predetermined location, wherein the stop 250 has a diameter greater then the inside diameter of the connector 235.

As the shade 215 is retracted, the guide cords 225 pass through connectors 235. This movement does not affect the PC array 5 until the stops 250 impact the connectors 235 at which point the suspension cords 230 and the PC array 5 attached thereto are pulled upwardly. It is to be appreciated that the relative vertical position of the PC array 5 as it is pulled upwardly is about equal to or above the foot rail 220 of the shade 215 thereby keeping it generally hidden from view.

Figure 12 illustrates the backside of a second embodiment of a roll-up shade according to the present invention, wherein the PC array 5 is mounted to the foot rail 220. Additionally, the battery pack 10 can be mounted in the foot rail 220. Electrical wires 235 extend from the PC array 5 to the head rail 205 wherein they are passed into a motor 30 contained within the roller 200 as will be discussed in greater detail herein. As shown, the wires 235 are slidably coupled to a pair of guide cords 225 by a plurality of connectors 255. The connectors 255 as illustrated in Figure 12A are similar to the connectors 245 described with reference to Figure 10A except they are fixedly attached to the electrical wire 235 at predetermined location via the clamp portion 260. A small vertical distance above the foot rail 220 on each of the guide cords 225 a stop 250 of the types described above is fixedly attached to each guide cord 225. As the shade 215 is retracted, the stops 250 contact the bottommost connectors 255 and push them upwardly. Next, the bottommost connectors 255 contact the connectors 255 located directly above, which are then pushed upwardly as well. This process continues until all the connectors 255 are gathered at the top of the roll-up shade proximate the head rail 205. It can be appreciated that the portions of the electrical wires 235 spanning the distance between two connectors 255 form loops which gather with the connectors 255 proximate the head rail 205 above the retracted foot rail 220, generally hidden from view from the front of the roll-up shade.

Figure 13 is a side view of a third embodiment of a roll-up shade according to the present invention. PC array 5 hangs from the head rail 205 by electrical wires 235 and/or suspension cords 230 between the back side of the shade 215 and a window pane. Hook or catch arms 265 extend from the surface of the foot rail 220 directly below and aligned with the PC array 5. As the shade 215 is retracted the hooks or catch arms 265 receive the PC array 5 and push it upwardly above the surface of the window. It is understood that although a catch arm 265 is illustrated in Figure 13, any number of mechanisms that would be obvious to one of ordinary skill given the benefit of this disclosure could be utilized to engage the PC array 5 during the retraction of the shade 215 and disengage the PC array 5 during extension of the shade 215. Alternatives include, but are not limited, to magnets, catch rods attached to the PC array to be received into corresponding bores in the foot rail, and slots defined in the foot rail to cradle the PC array.

Figure 14 illustrates a fourth embodiment of a roll-up shade assembly according to the present invention. The roll-up shade assembly comprises a roll-up cellular shade 270 in which the individual cells collapse as they are rolled onto a roller 200. The PC array 5 and optionally the battery pack 10 (not shown) are located in the foot rail 220. The electrical wires 235 connecting the PC array 5 to the rest of the basic lift circuit 1 are routed inside of the cells of the shade 270, wherein they are wrapped around the roller 200 with the shade 270 as it is retracted. The electrical wires 235 can be passed through a hole in the roller 200 and connected to a motor 30 contained within the bore 210 of the roller 200.

Figure 15 is a sectional view of a roller assembly indicating one means for routing the electrical wires into the roller 200 for connection with a motor 30 in the third embodiment or a variation thereof. As shown, the motor 30 is fixedly mounted to the inside bore 210 of the roller with the rotating shaft of the motor 30 extending out from one end of the roller where it is affixed to a mounting bracket 275. It is noted that the mounting bracket 275 may be part of a head rail 205 which is not shown. At the other end of the roller, a shaft 280 of the mounting bracket 285 is rotateably received in a bearing assembly 280. The ends of the wires pass through a hole 295 in the roller 200 into the bore 210 wherein they are attached to the motor's electrical connections. When the motor 30 is actuated, the motor rotates in unison with the roller 200 about the motor's shaft, thereby retracting or extending the shade 215. Although not shown, the control circuit 20 could also be contained within the bore 210 of the roller 200 or it might be contained within the foot rail 220 with the PC array 5 and the battery pack 10. The basic lift circuit 1 may also include a rotation sensor of the type well known in the electrical arts contained within the roller 200 to provide data to the control circuit 20 to prevent the shade 215 from retracting or extending too far. Other methods of electrically coupling the wires 235 in a rotating roller with a fixed motor 30 are also contemplated such as using bushings as would be known to someone of ordinary skill in the electrical arts.

Several of the embodiments described above and the basic lift circuit 1 used therewith utilize a IR or radio receiver 25 to receive and transfer signals transmitted from a remote control to the control circuit for retracting and extending the associated window covering. Figures 16 to 17 illustrate a control pendant 300 comprising a two way switch 305 that hangs from a head rail or mounting bracket. By activating the switch 305 the shade of the window covering is either retracted or extended. The interior of the pendant is hollow wherein the batteries may be contained. Electrical wires 310 are routed through a cable 315 that attaches the pendant 300 to a mounting bracket 320 or a head rail. In the variation illustrated herein the backside of the pendant 300 that would normally be facing a window opening has a PC array 5 attached thereto for charging the batteries and providing additional power to the basic lift circuit 1. Since the pendant 300 hangs down from the bracket 320 to a position that is easily reached by a potential window covering operator, it will typically not be obstructed by the upper framework of a window.

It is to be appreciated that the pendant 300 is typically situated on the front side of the window covering where it will be prevented from receiving direct sunlight when the window covering is in its extended position. This is in contrast to the PC arrays 5 of the other embodiments described above that cause the PC array 5 to be lowered when the shades are lowered and retracted from the sunlight when the shades are raised. It follows that the control pendant 300 incorporating a PC array 5 would be best utilized on a window covering that is typically retracted during the daylight hours and extended during the evening hours.

Figures 18 to 20 illustrate a bracket 320 that can be used to attach the control pendant 300 to a roll-up style shade along with a means for passing the electrical wiring 310 from the pendant 300 into the interior bore 210 of the roller 200. Figure 18 shows a side view of the bracket 320 which has multiple slots 325 for receiving screws or other fasteners to affix the bracket 320 to the sides of a window frame. Figure 19 shows a section of the bracket 320 illustrating the means by which the pendant 300 is attached thereto. The bracket 320 includes a cylindrical extension 330 with a partially closed face 335 with a centered hole 340 passing through it. A mounting fixture 345 to which the cable 315 containing the pendant's electrical wiring 310 is connected is fit over the cylindrical extension 330 with a second portion 350 of the fixture 345 being received in the hole 340 and snapped in place. A bore 355 is provided through the fixture 345 from the connection with the cable 315 to an exit through the second portion 350. The electrical wires 310 pass through the bore 355 and as shown in Figure 19, are routed adjacent to the mounting bracket 320, wherein they are passed into the bore 210 of the roller 200 and connected with the remainder of the basic lift circuit 1.

Figure 20 shows a section of the bracket 320 and the roller 200 illustrating the means of connecting the roller 200 to the bracket 320. Further, it indicates one means for passing the wires 310 from the pendant 300 (or from the PC arrays in the first and second embodiments) into the bore 210 of the roller 200. The bracket 320 includes a second cylindrical extension 360 having an outside diameter less than the diameter of the roller bore 210. The second cylindrical extension 360 further includes a face 365 having a centered hole 370 thereon for receiving a motor mount 375. The motor mount 375 is centered in the interior of the bore 210 by a bearing member 380. The other end of the motor mount includes means for attaching a motor 30 and/or control circuit 20 thereto. The shaft of the motor is then received in a shaft mount 385 that is fixedly attached to the interior wall of the roller 200, such that actuation of the motor 30 causes the roller 20 to rotate around the motor 30 and control circuit 20 contained therein. The electric wires 310 from the pendant 300 are passed into the roller 200 through a path 390 in the motor mount 375 wherein they are connected to the control circuit 20 or the motor 30.

Although the present invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made by way of example, and changes in detail or structure not specifically discussed herein may be made without departing from the spirit of the invention as defined in the appended claims.

Claims

What is claimed is:

1. A solar powered covering for an architectural opening comprising:

   a head rail for mounting to a frame;

   a foot rail operatively connected with the head rail;

   a shade material spaced between the head rail and the foot rail, the shade material suspended from the head rail; and

   a motorized lift system for retracting or extending the shade, the motorized lift system including (i) an electric motor mounted to either the head rail or the foot rail, (ii) one or more rechargeable alkaline managanese (RAM) batteries electrically coupled with the motor, and (iii) one or more photovoltaic cells electrically coupled with the one or more RAM batteries.

2. The solar powered covering of claim 1, further comprising one or more lift cords, each of the one or more lift cords having two ends, one of the two ends being coupled with a rotational shaft of the motor at either the foot rail or the head rail for unitary rotational motion with the rotational shaft, and the other end being attached to the other of the head rail or the foot rail.

3. The solar powered covering of claim 1, wherein the motorized lift system further comprises a control circuit electrically coupled to the motor for reversing the direction of current flow through the motor.

4. The solar powered covering of claim 1, wherein the motorized lift system further comprises a Zener diode electrically coupled in parallel with the one or more photovoltaic cells and the one or more RAM batteries.

5. The solar powered covering of claim 1, wherein the covering is a cellular shade.

6. The solar powered covering of claim 1, wherein the covering is a Venetian blind.

7. The solar powered covering of claim 1, wherein the covering is a roll-up shade.

8. The solar powered covering of claim 2, wherein each end of the one or more lift cords is coupled with the rotational shaft of the motor through a capstan.

9. A solar powered covering for an architectural opening comprising:

a head rail for mounting to a frame;

a foot rail operatively coupled with the head rail by one or more lift cords;

a shade material spaced between the head rail and the foot rail, the shade material suspended from the head rail; and

a motorized lift system for retracting or extending the shade, the motorized lift system being contained entirely within or on the foot rail and including (i) an electric motor assembly having a motor with a rotational shaft, the rotational shaft coupled with at least one of the one or more lift cords, (ii) a battery pack having one or more rechargeable batteries electrically coupled with the motor, and (iii) a photovoltaic cell array having one or more photovoltaic cells electrically coupled with the battery pack.

10. The solar powered covering of claim 9, wherein the motorized lift system further comprises a control circuit electrically coupled to the motor for reversing the direction of current flow through the motor, the control circuit being substantially contained within the foot rail.

11. The solar powered covering of claim 10, wherein a receiver for receiving operational signals from a remote control is electrically coupled with the control circuit.

12. The solar powered covering of claim 11, wherein the receiver is an infrared (IR) receiver.

13. The solar powered covering of claim 12, wherein the infrared (IR) receiver is located on the foot rail.

14. The solar powered covering of claim 13, further comprising an IR reflector attached to the head rail, the IR reflector being angled to reflect IR signal incident thereon to the IR receiver.

15. The solar powered covering of claim 12, wherein the infrared (IR) receiver is located on the head rail and is electrically coupled to the control circuit in the foot rail by one or more electrical wires contained in the shade material.

16. The solar powered covering of claim 9, wherein the one or more rechargeable batteries are RAM batteries.

17. The solar powered covering of claim 9, wherein the foot rail further comprises one or more latch arms configured to receive and secure one or both of the

motor assembly and the battery pack to the foot rail.

18. The solar powered covering of claim 17, wherein the motorized lift system further comprises a control circuit electrically coupled to the motor for reversing the direction of current flow through the motor, the control circuit being secured within the one or more latch arms.

19. The solar powered covering of claim 17, wherein the one or more latch arms comprise a first latch arm and a second latch arm opposite and generally parallel to the first latch arm, each latch arm extending at least a substantial portion of the longitudinal length of the foot rail, and wherein the battery pack and the motor assembly can be snapped in between the first and second latch arms at any longitudinal location along the length of the first and second latch arms.

20. The solar powered covering of claim 19, wherein the first and second latch arms extend the entire longitudinal length of the foot rail.

21. The solar powered covering of claim 9, wherein the foot rail further comprises an electrical bus, the electrical bus comprising a plurality of conductive strips applied to a surface of the foot rail.

22. The solar powered covering of claim 21, wherein one or both of the battery pack and the motor assembly have one or more spring connectors for electrically coupling to the electrical bus.

23. The solar powered covering of claim 10, wherein the electrical connections between one or all of the battery pack, the control circuit and the motor

assembly do not utilize electrical wires.

24. The solar powered covering of claim 19, wherein the foot rail further comprises an electrical bus, the electrical bus comprising a plurality of conductive strips applied to a surface of the foot rail between the first and second latch arms, and wherein the motor assembly and the battery pack each include one or more connectors that make contact with the electrical bus when snapped between the first and second latch arms.

25. The solar powered covering of claim 24, wherein the conductive strips of the electrical bus and the one or more connectors of the motor assembly and the battery pack are configured such that the motor assembly and the battery pack can be snapped into place anywhere along the length of the first and second latch arms to form the electrically coupled motorized lift system.

26. The solar powered covering of claim 9, wherein the rotational shaft of the motor is coupled with the at least one of the one or more lift cords through a capstan.

27. The solar powered covering of claim 9, wherein the photovoltaic cell array is mounted to an outside surface of the foot rail, and is covered by a protective lens.

28. The solar powered covering of claim 9, wherein the photovoltaic cell array is mounted to an outside surface of the foot rail, and a bumper extends horizontally beyond the surface of the photovoltaic cell array whereby the photovoltaic cell array is protected from impact against the surface of a window when the window covering is mounted in a window frame.

29. A solar powered covering for an architectural opening comprising:

a head rail for mounting to a window frame;

a foot rail operatively coupled with the head rail;

a shade material spaced between the head rail and the foot rail, the shade material suspended from the head rail; and

a motorized lift system for retracting or extending the shade, the motorized lift system including (i) an electric motor mounted to the head rail, (ii) one or more rechargeable batteries contained within either the head rail or the foot rail and electrically coupled with the motor, (iii) one or more photovoltaic cells attached to the surface of the foot rail and electrically coupled with the motor at least partially by the electrical cable and (iv) one or more electrical wires spanning the distance between the head rail and the foot rail, the electrical wires for electrically coupling the motor with the one or more photovoltaic cells.

30. The solar powered covering of claim 29, further comprising one or more lift cords, each of the one or more lift cords having two ends, one of the two ends being coupled with a rotational shaft of the motor for unitary rotational motion with the rotational shaft, and the other end being attached to the foot rail.

31. The solar powered covering of claim 29, wherein the motorized lift system further comprises a control circuit electrically coupled to the motor for reversing the direction of current flow through the motor.

32. The solar powered covering of claim 29, wherein the covering is a cellular

shade and the one or more electrical wires are routed inside of the cells of the shade material between the foot rail and the head rail.

33. The solar powered covering of claim 32, wherein the one or more electrical wires are coiled, each coiled electrical wire being partially uncoiled when the cellular shade is extended.

34. The solar powered covering of claim 29, the one or more electrical wires are routed in an interior of the shade material between the foot rail and the head rail.

35. The solar powered covering of claim 29, wherein the covering is a roman-style shade and the electrical cable is routed between the foot rail and the head rail in a hem of the shade material.

36. The solar powered covering of claim 29, wherein the covering is a roll-up shade.

37. The solar powered covering of claim 29, wherein the one or more rechargeable batteries are RAM batteries.

38. The solar powered covering of claim 29, wherein the one or more rechargeable batteries are contained within the foot rail.

39. A solar powered covering for an architectural opening comprising:

a head rail for mounting to a frame;

a foot rail operatively connected with the head rail;

a shade material spaced between the head rail and the foot rail, the shade material suspended from the head rail; and a motorized lift system for retracting and extending the shade, the motorized lift system including (i) an electric motor mounted to either the head rail or the foot rail, (ii) one or more rechargeable batteries electrically coupled with the motor, and (iii) one or more photovoltaic cells electrically coupled with the one or more rechargeable batteries, the one or more photovoltaic cells suspended from the head rail by one or more cords or electrical cables.

40. The solar powered covering of claim 39, wherein the solar cell is retracted when the shade is retracted.

41. The solar powered covering of claim 39, wherein the motorized lift system further comprises a control circuit electrically coupled to the motor for reversing the direction of current flow through the motor.

42. The solar powered covering of claim 39, further comprising a catch member extending from the foot rail, the catch member located underneath the one or more photovoltaic cells, wherein as the shade is retracted, the one or more photovoltaic cells are caught by the catch and the one or more photovoltaic cells are retracted to a position proximate the head rail.

43. A roll-up shade comprising:

a pair of mounting brackets for attachment to a frame;

a roller rotatably coupled with the brackets;

a shade material, the shade material including a first edge fixedly attached to the roller; and a motorized lift system for rolling the shade material on to or off of the roller tube, the motorized lift system including (i) an electrical motor for turning the roller, and (ii) a switch pendent suspended from one bracket of the pair of brackets by a cable or electrical wire, the switch pendant including a) a set of one or more rechargeable batteries contained therein, b) a switch electrically coupled to the batteries and the motor and (iii) one or more photovoltaic cells electrically coupled with the one or more rechargeable batteries.

44. The roll-up shade of claim 43, wherein the pair of brackets comprise a head rail.

45. The roll-up shade of claim 43, wherein the one or more photovoltaic cells are disposed on the outside surface of the pendent.

46. A solar powered covering for an architectural opening comprising:

a head rail for mounting to a frame;

a foot rail operatively connected with the head rail;

a shade material spaced between the head rail and the foot rail, the shade material suspended from the head rail;

a motorized lift system for retracting and extending the shade, the motorized lift system including (i) an electric motor mounted to either the head rail or the foot rail, the motor configured to retract or extend the shade material (ii) one or more rechargeable batteries electrically coupled with the motor, (iii) one or more photovoltaic cells electrically coupled with the one or more rechargeable batteries, (iv) a control circuit for reversing the direction of current flow through the motor, and (v) an infrared receiver mounted on the foot rail, the infrared receiver electrically coupled with the control system for receiving operational signals from a remote control.

47. The solar powered covering of claim 46 further comprising a first infrared reflector, the infrared reflector mounted on the head rail, the first infrared reflector being angled to reflect infrared signals incident thereon downwardly towards the foot rail.

48. The solar powered covering of claim 47, further comprising a second infrared reflector mounted on the foot rail, the second infrared reflector being angled to reflect infrared signals received from the first infrared reflector towards the infrared receiver.

49. The solar powered covering of claim 47, wherein the first infrared reflector is positioned directly above the infrared receiver.

50. The solar powered covering of claim 49, wherein the second infrared reflector is positioned directly below the infrared receiver.

51. A roll-up shade comprising:

a head rail for attachment to a frame;

a roller rotatably coupled with the head rail;

a shade material, the shade material including a first edge fixedly attached to the roller and a second edge opposite the first edge;

and

a motorized lift system for rolling the shade material on to or off of the roller, the motorized lift system including (i) an electrical motor for turning the roller, and (ii) a battery pack having one or more rechargeable batteries, and (iii) a photovoltaic cell array having one or more photovoltaic cells electrically coupled with the one or more rechargeable batteries, the photovoltaic cell array suspended from the head rail by one or more suspension cords or electrical wires.

52. The roll-up shade of claim 51, further comprising:

a pair of parallel substantially vertically orientated guide cords having top and bottom ends, the pair of guide cords connected at top and bottom ends to the shade material for integral motion therewith, at least one guide cord of the pair of guide cords having a stop member fixedly attached to the guide cord generally proximate the bottom end, the stop member having a breadth dimension greater than the diameter of the corresponding guide cord; and

a slide connector fixedly attached to one of the one or more suspension cords or electrical wires, the slide connector also slidably connected to the at least one guide cord above the stop member; whereby as the shade is retracted on to the roller, the stop member is lifted vertically into the slide connector, the slide connector is then pushed upwardly by the stop member and consequently the photovoltaic cell array is pulled upwardly via the slide connector through the one suspension cord or electrical wire attached thereto.

53. The roll-up shade of claim 51, wherein the roller is at least partially hollow and the motor is substantially contained within the roller.

54. The roll-up shade of claim 53, wherein the motor is fixedly coupled with the head rail and a rotational shaft of the motor is attached to the roller.

55. The roll-up shade of claim 53, wherein the motor is fixedly attached to roller and a rotational shaft of the motor is coupled with the head rail.

56. The roll-up shade of claim 51, further comprising:

a foot rail attached to the second edge of the shade material; and

a catch member attached to and extending from the foot rail, the catch member positioned on the foot rail at least partially underneath the photovoltaic cell array, wherein as the shade is retracted, the photovoltaic cell array is caught by the catch and the photovoltaic cell array is retracted to a position proximate the head rail.

57. The roll-up shade of claim 51, wherein the roller is at least partially hollow and the battery pack is contained therein.

58. The roll-up shade of claim 51, wherein a foot rail is attached to the second edge of the shade material and the battery pack is contained therein.

59. A roll-up shade comprising:

a head rail for attachment to a frame;

a roller rotatably coupled with the head rail;

a shade material, the shade material including a first edge fixedly attached to the roller and a second edge opposite the first edge;

a foot rail attached to the second edge of the shade material; and

a motorized lift system for rolling the shade material on to or off of the roller, the motorized lift system including (i) an electrical motor attached to the head rail for turning the roller, and (ii) a battery pack having one or more rechargeable batteries, (iii) a photovoltaic cell array having one or more photovoltaic cells electrically coupled with the one or more rechargeable batteries, the photovoltaic cell array attached to the foot rail and (iv) one or more electrical cords, the electrical cords extending from the foot rail to the head rail to electrically couple the motor and the photovoltaic cell array.

60. The roll-up shade of claim 59, further comprising:

one or more guide cords, each guide cord adjacent to and extending vertically over at least a substantial portion of the distance between the fist and second edges of the shade material, each cord having (i) top and bottom ends that are directly or indirectly attached to shade material and (ii) a stop member fixedly attached to the cord at a location proximate the bottom end; and

a plurality of slide connectors affixed to and spaced along the one or more electrical wires, each slide connector also being slideably attached to a guide cord of the one or more guide cords at a location above the stop member of the guide cord, the stop member having a dimensional breadth that prevents the closed slide connector from sliding past the stop member along the guide cord.

61. A solar powered covering for an architectural opening comprising:

a head rail for mounting to a frame;

a foot rail operatively connected with the head rail;

a shade material spaced between the head rail and the foot rail, the shade material attached to and suspended from the head rail at a top edge and attached to the foot rail at a bottom edge; and

a motorized lift system for retracting and extending the shade, the motorized lift system including the following components: (i) an electric motor mounted to either the head rail or the foot rail, the motor configured to retract or extend the shade material (ii) one or more rechargeable batteries electrically coupled with the motor, (iii) one or more photovoltaic cells electrically coupled with the one or more rechargeable batteries, the one or more photovoltaic cells attached to the foot rail and (iv) one or more electrical wires for electrically coupling the other components of the motorized lift system, the one or more electrical wires extending from the foot rail to the head rail.

62. The solar powered covering of claim 61, wherein the components of the

motorized lift system further include (1) a control circuit electrically coupled to the motor for reversing the direction of current flow through the motor and (2) a infrared receiver for receiving operational signals from a remote control.

63. The solar powered covering of claim 62, wherein the one or more electrical wires electrically couple the infrared receiver attached to the head rail to other components of the motorized lift system in the foot rail.

64. The solar powered covering of claim 61, wherein the one or more electrical wires are routed through an interior of the shade material.

65. The solar powered covering of claim 64, wherein the one or more electrical wires are coiled.

66. The solar powered covering of claim 1, wherein the one or more photovoltaic cells comprises amorphous photovoltaic cells.

67. The solar powered covering of claim 4, wherein the one or more photovoltaic cells comprises amorphous photovoltaic cells.

68. A solar powered covering for an architectural opening comprising:

a head rail for mounting to a frame;

a foot rail operatively connected with the head rail;

a shade material between the head rail and the foot rail, the shade material suspended from the head rail; and a motorized lift system for retracting or extending the shade, the motorized lift system including (i) an electric motor mounted to either the head rail or the foot rail, (ii) one or more batteries electrically coupled with the motor, the one or more batteries being of a rechargeable type that does not exhibit a memory effect and (iii) one or more photovoltaic cells electrically coupled with the one or more batteries.

69. The solar powered covering of claim 68, wherein the one or more batteries comprise rechargeable alkaline manganese (RAM) batteries.

70. The solar powered covering of claim 68, wherein the one or more photovoltaic cells comprise polymorphous photovoltaic cells.

71. The solar powered covering of claim 68, wherein the one or more batteries comprise rechargeable alkaline manganese (RAM) batteries, and the one or more photovoltaic cells comprise polymorphous photovoltaic cells.

72. The solar powered covering of claim 68, wherein the motorized lift system further comprises a Zener diode electrically coupled in parallel with the one or more photovoltaic cells and the one or more batteries.

73. The solar powered covering of claim 71, wherein the motorized lift system further comprises a Zener diode electrically coupled in parallel with the one or more photovoltaic cells and the one or more batteries.

74. A circuit comprising:

a battery pack having one or more batteries, the one or more batteries being a type that does not exhibit "memory effect";

a photovoltaic cell array having one or more amorphous photovoltaic cells, the photovoltaic array being electrically coupled to the battery pack; and

an electrically powered device, the electrically powered device coupled with the battery pack and the photovoltaic cell array.

75. The circuit of claim 74, wherein the electrical device is a motor.

76. The circuit of claim 74, wherein the one or more batteries are rechargeable alkaline manganese (RAM) batteries.

77. The circuit of claim 76, further comprising a voltage regulator for limiting a recharging voltage provided to the Ram batteries from the photovoltaic array.

78. The circuit of claim 77, wherein the recharging voltage is limited to below 1.65 volts.

79. The circuit of claim 76, wherein the voltage regulator comprises a Zener diode,

80. The circuit of claim 79, wherein the Zener diode has a 2% or better variance tolerance.

81. The circuit of claim 76 configured for use in a covering for an architectural opening.

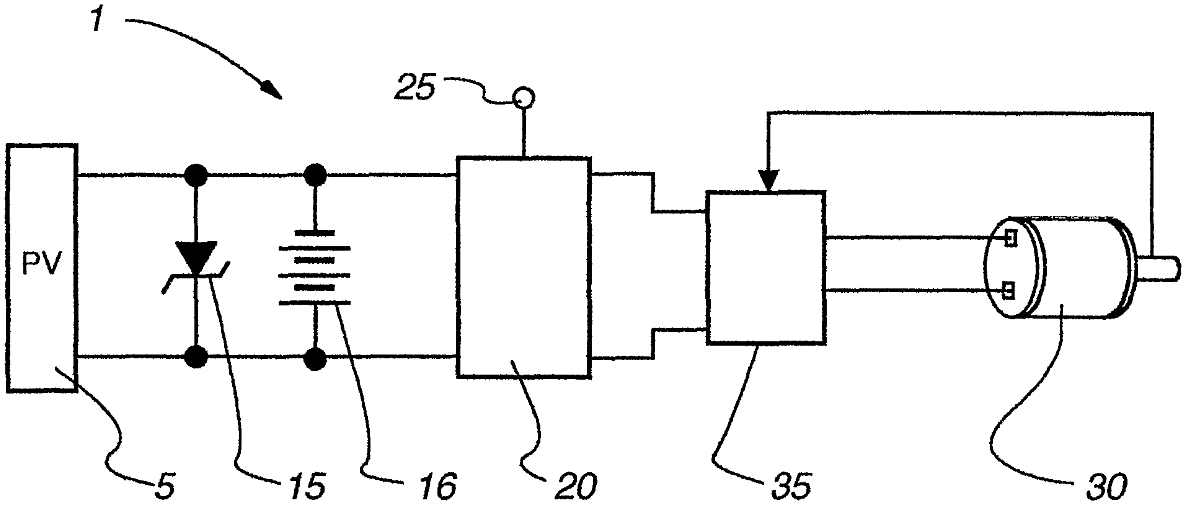

Fig. 1

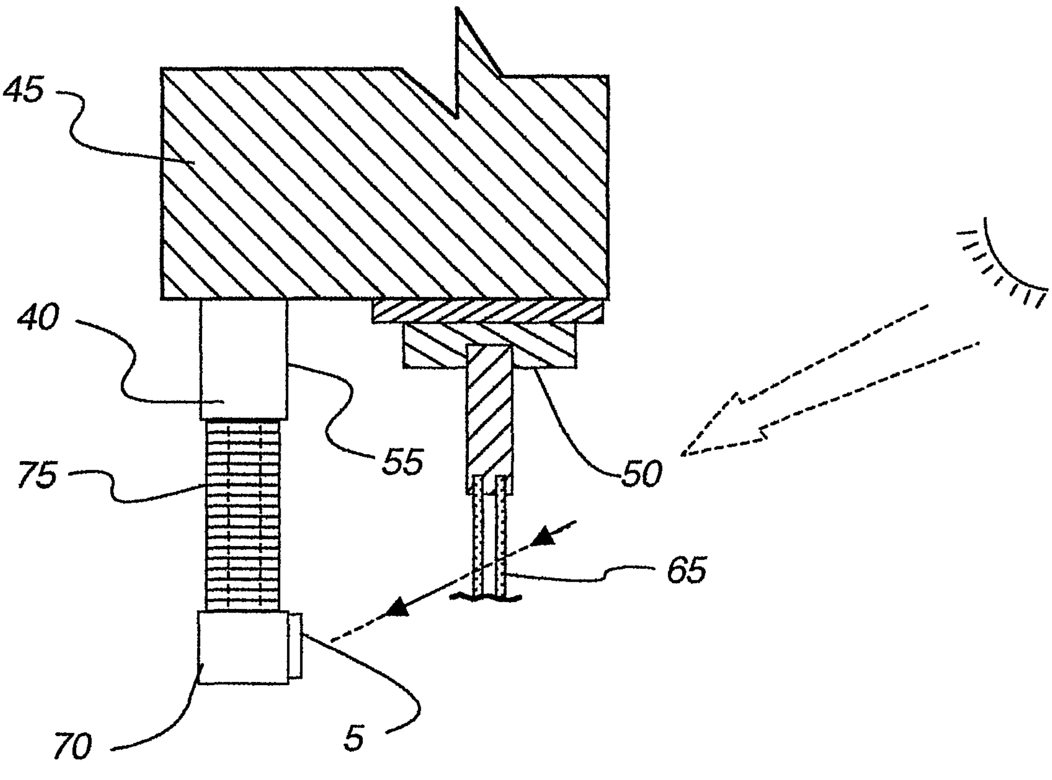

Fig. 2

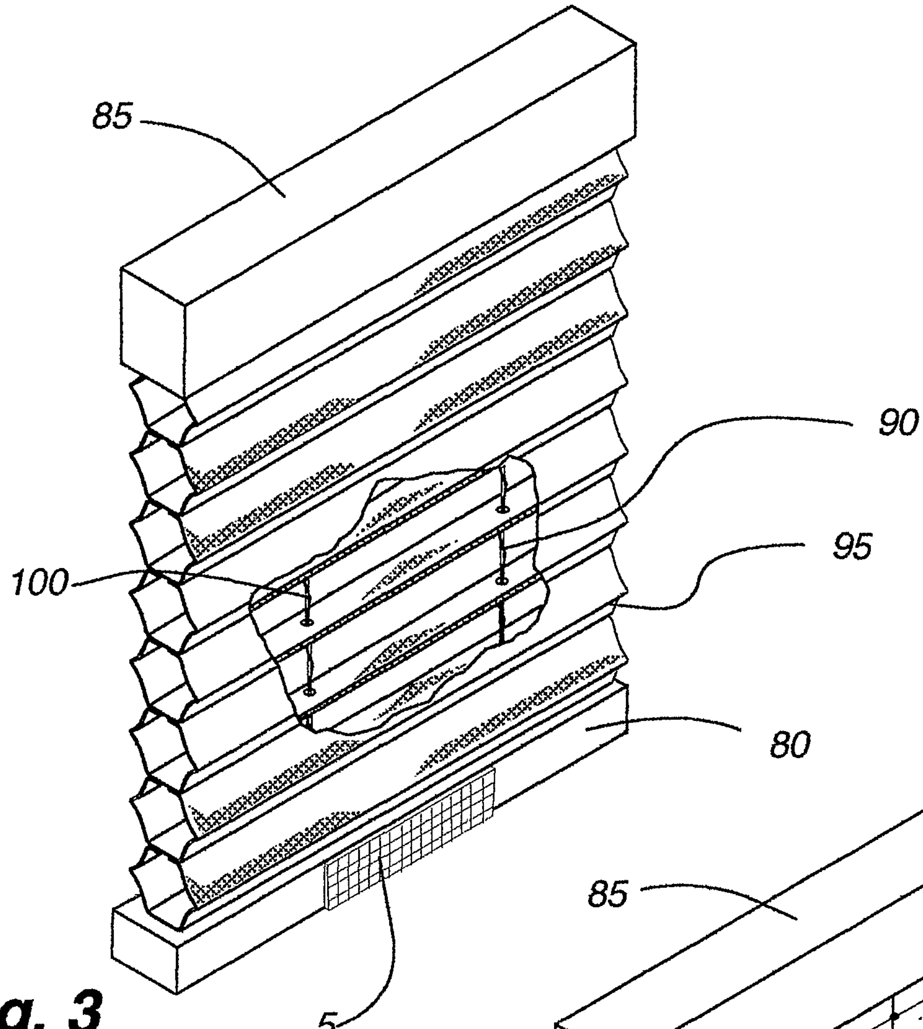

Fig. 3

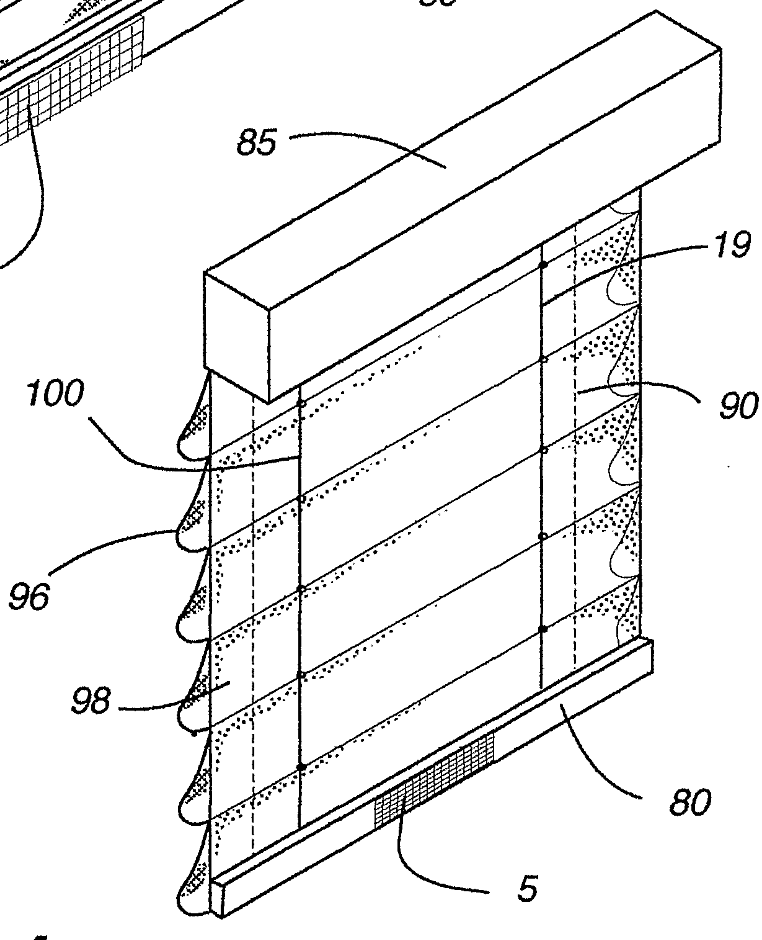

Fig. 4

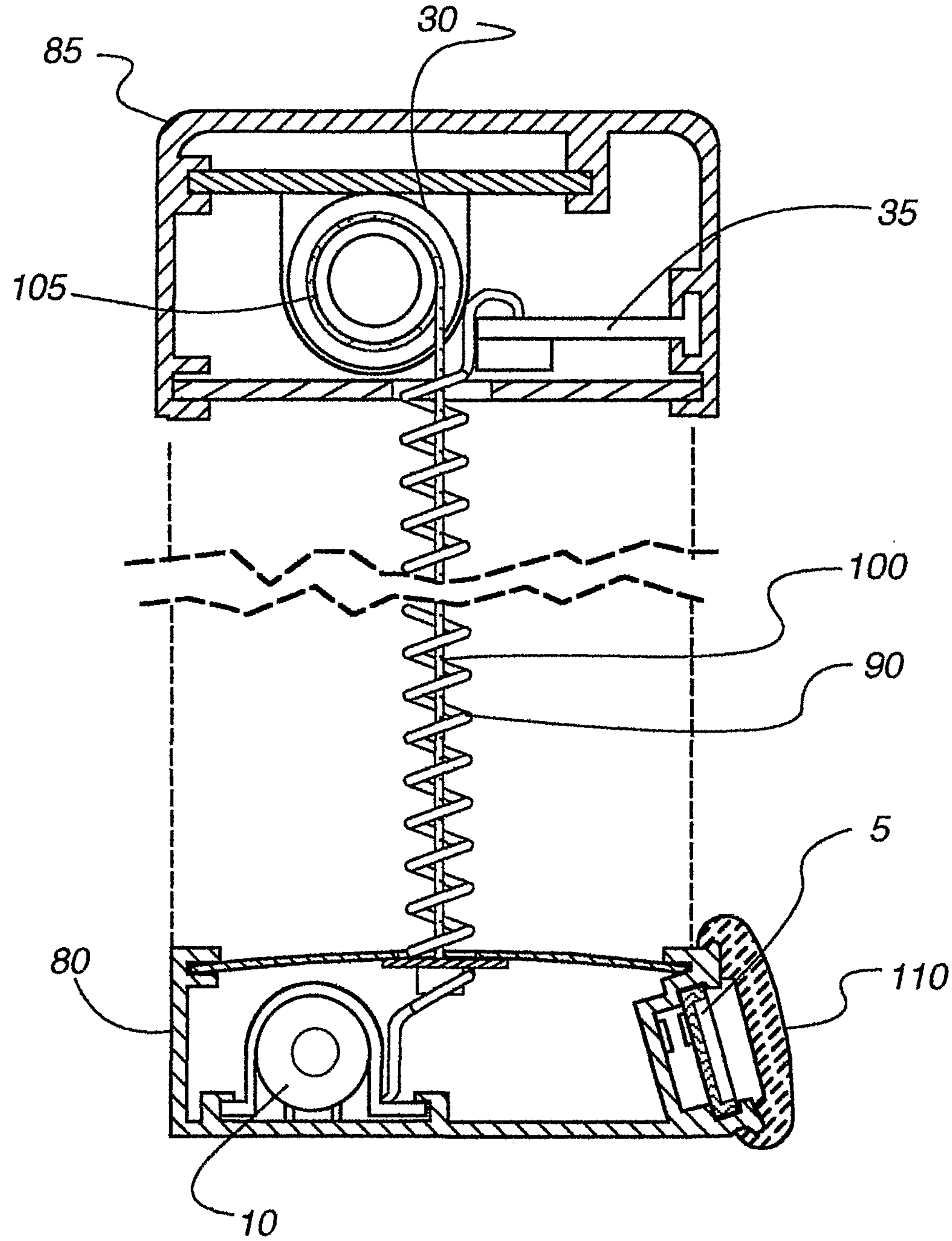

Fig. 5

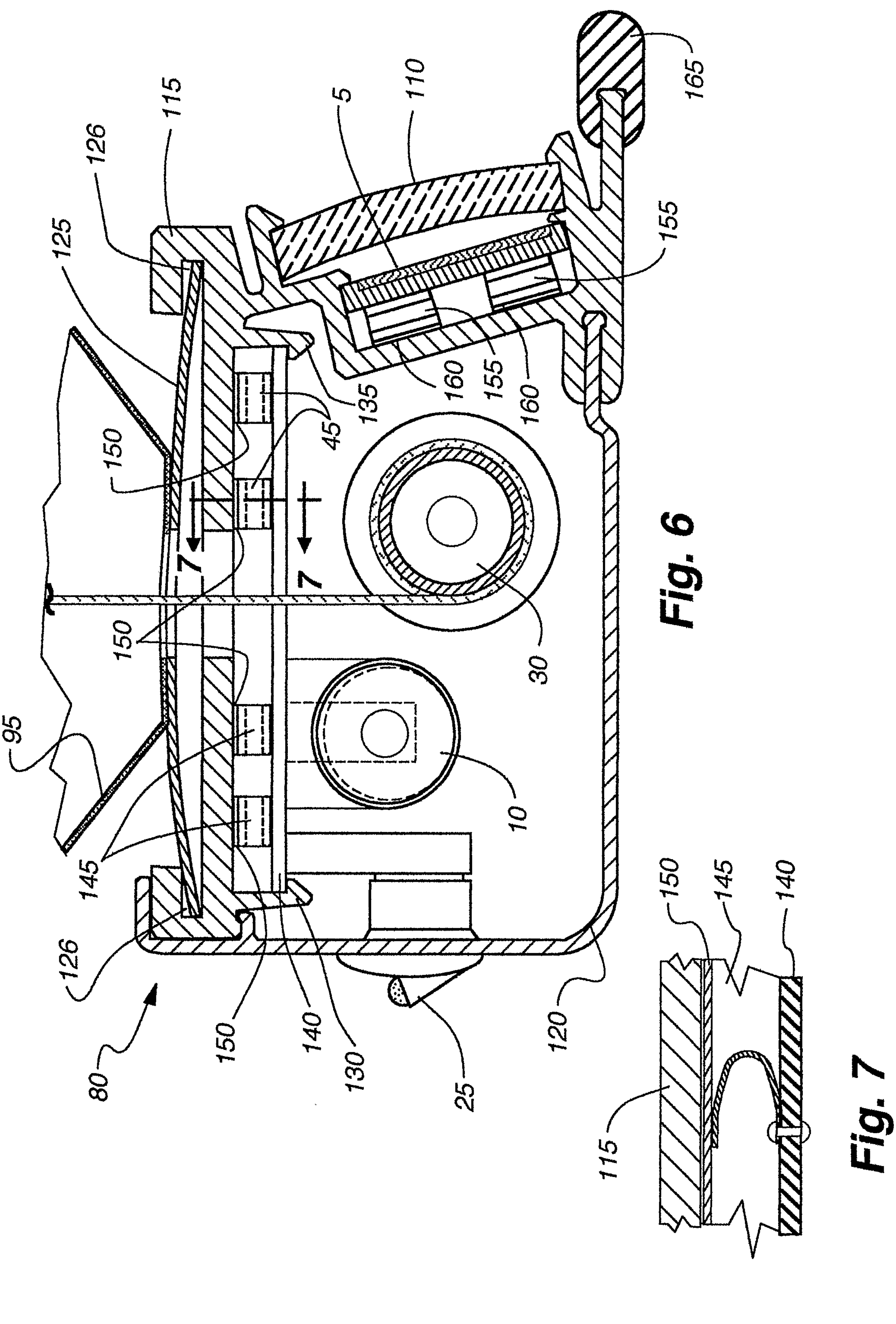
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Fig. 6

Fig. 7

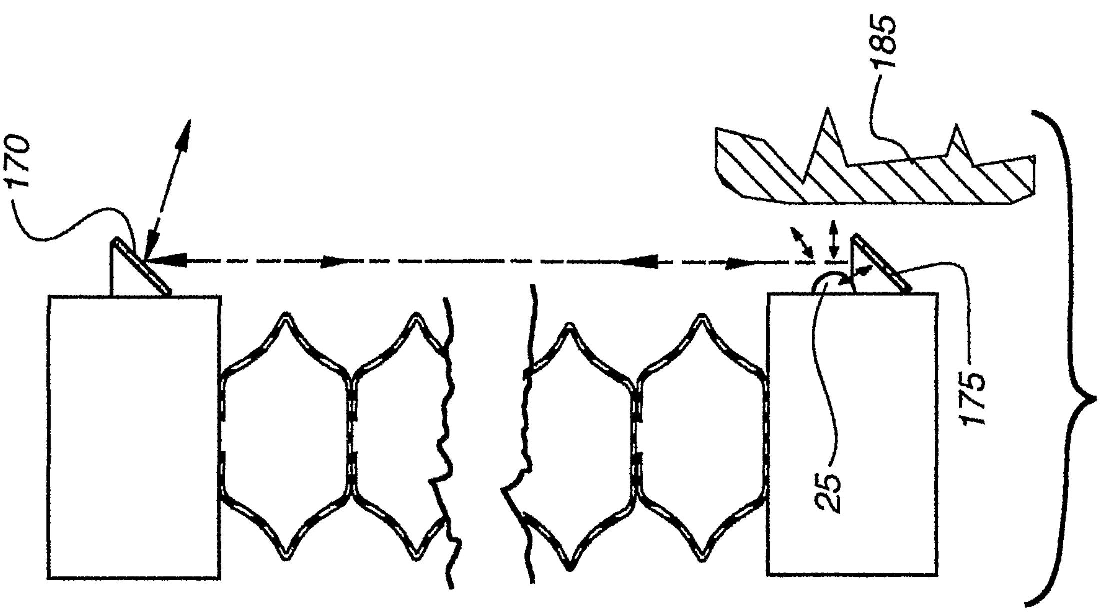

Fig. 9

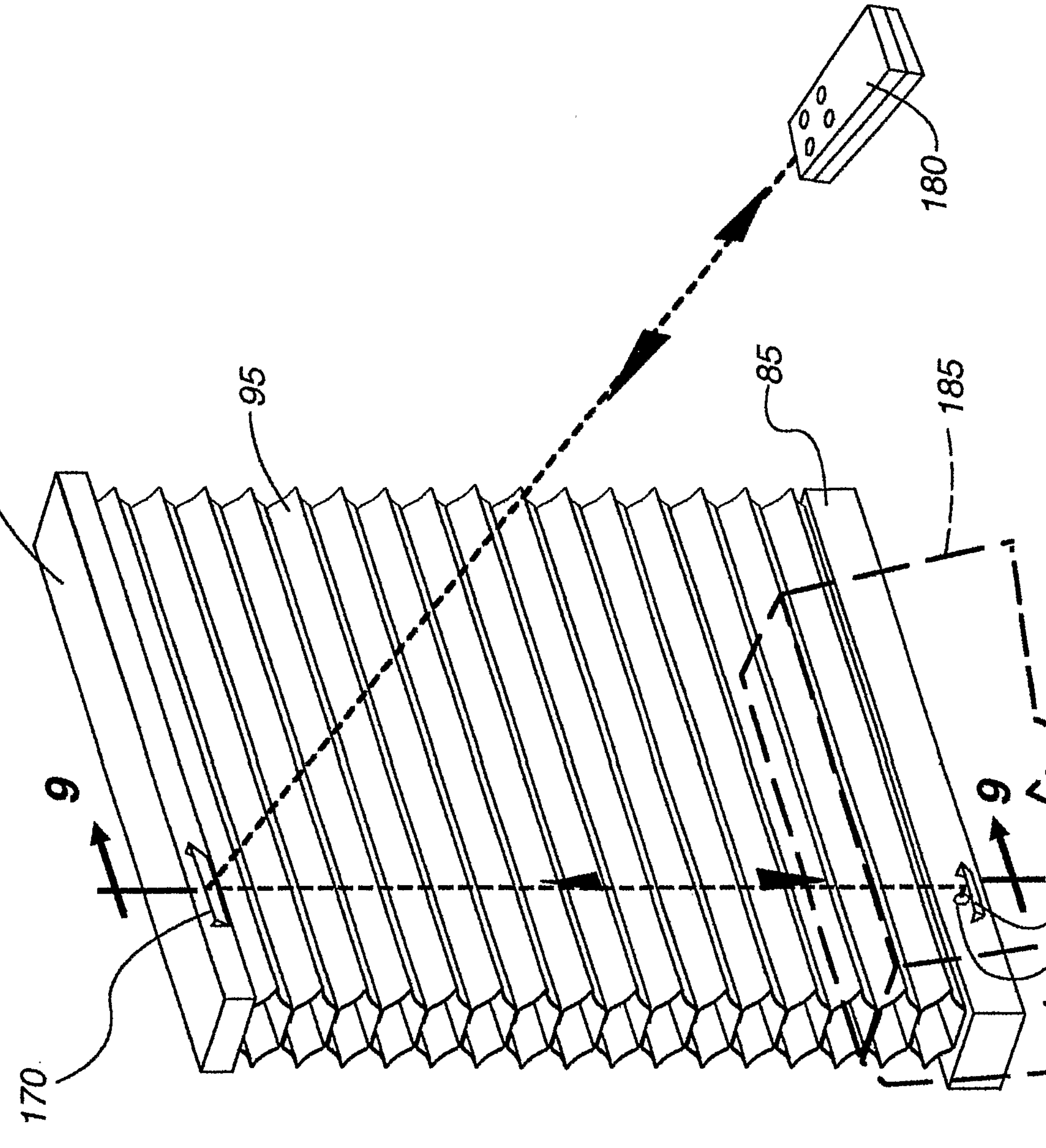

Fig. 8

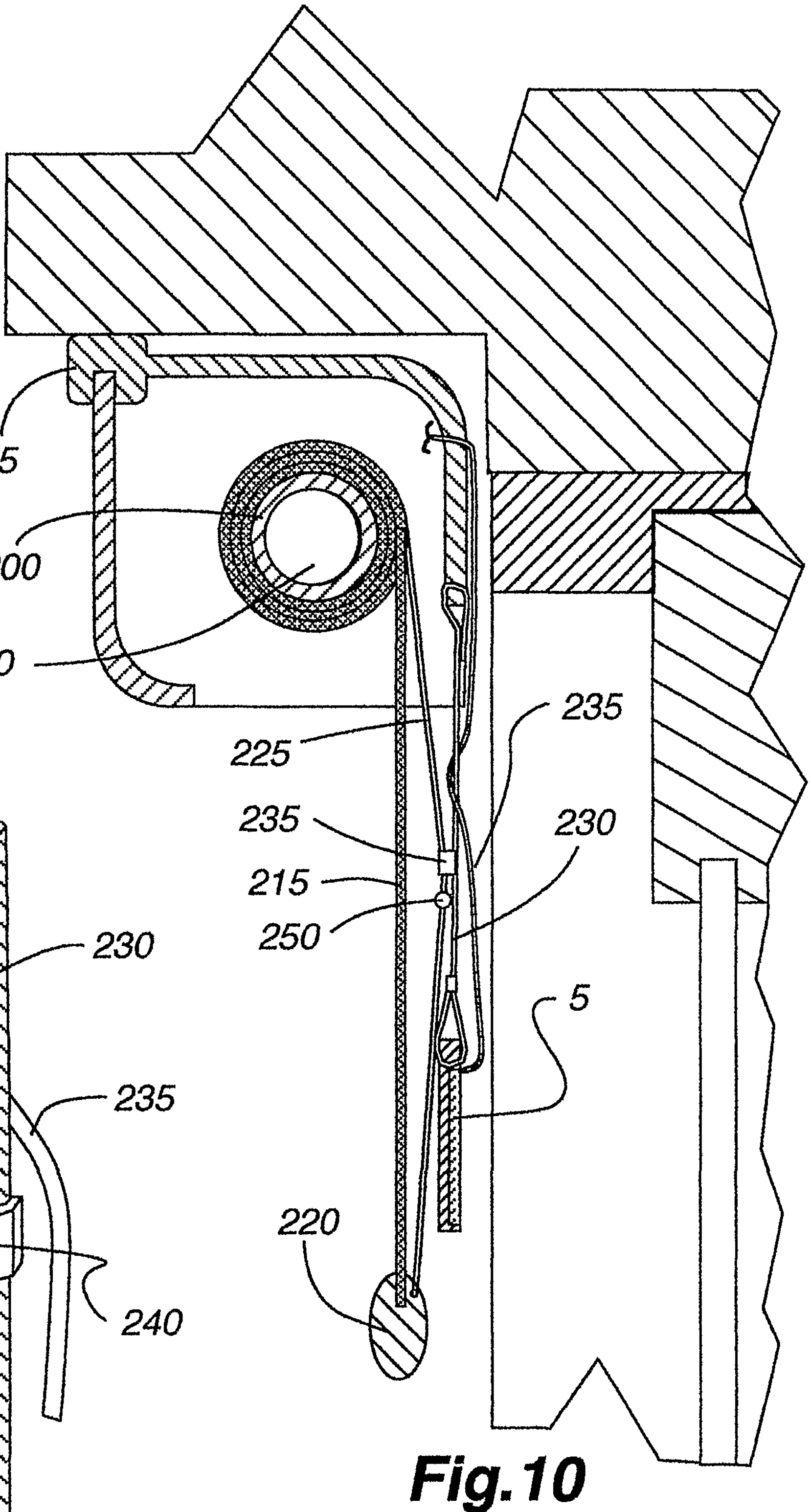

Fig.10

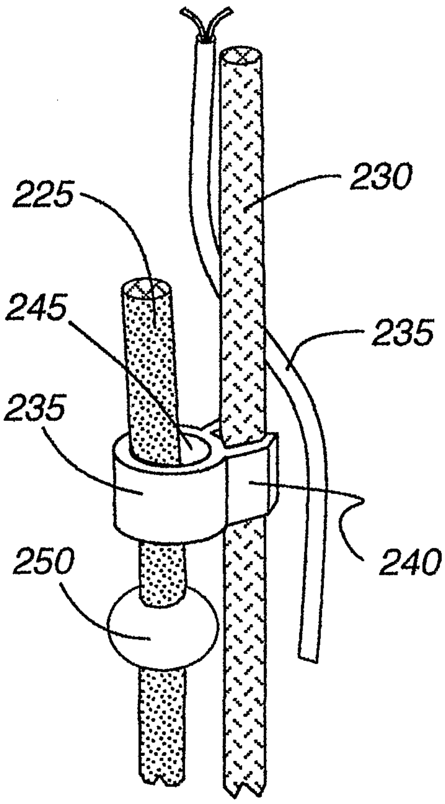

Fig. 10A

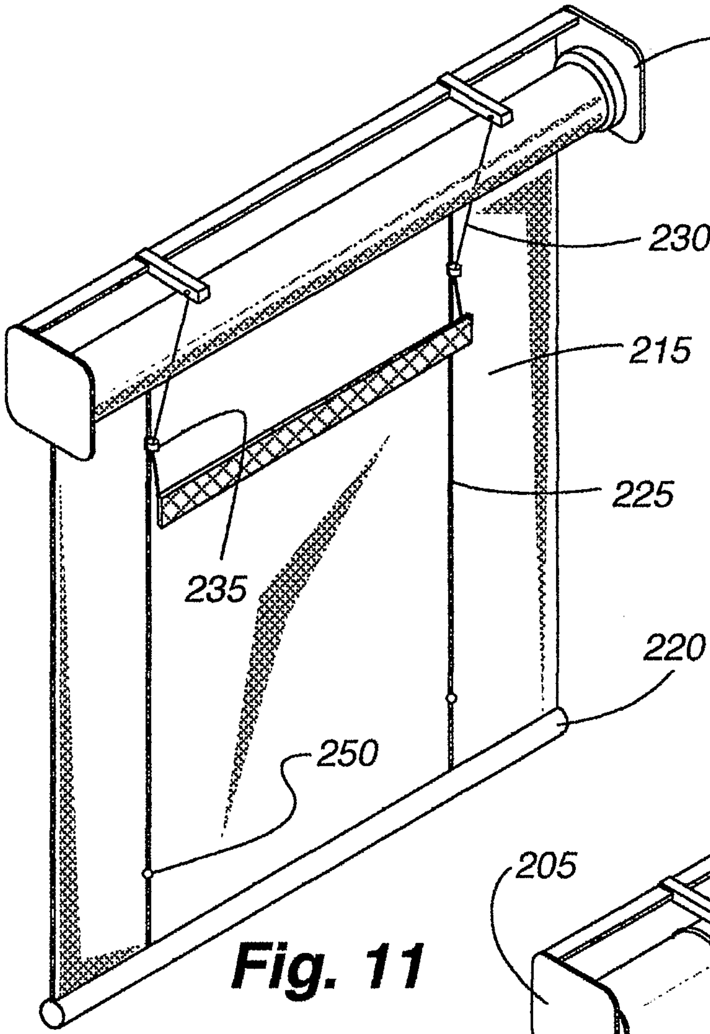

Fig. 11

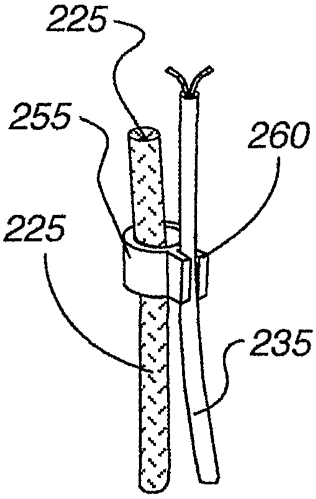

Fig. 12A

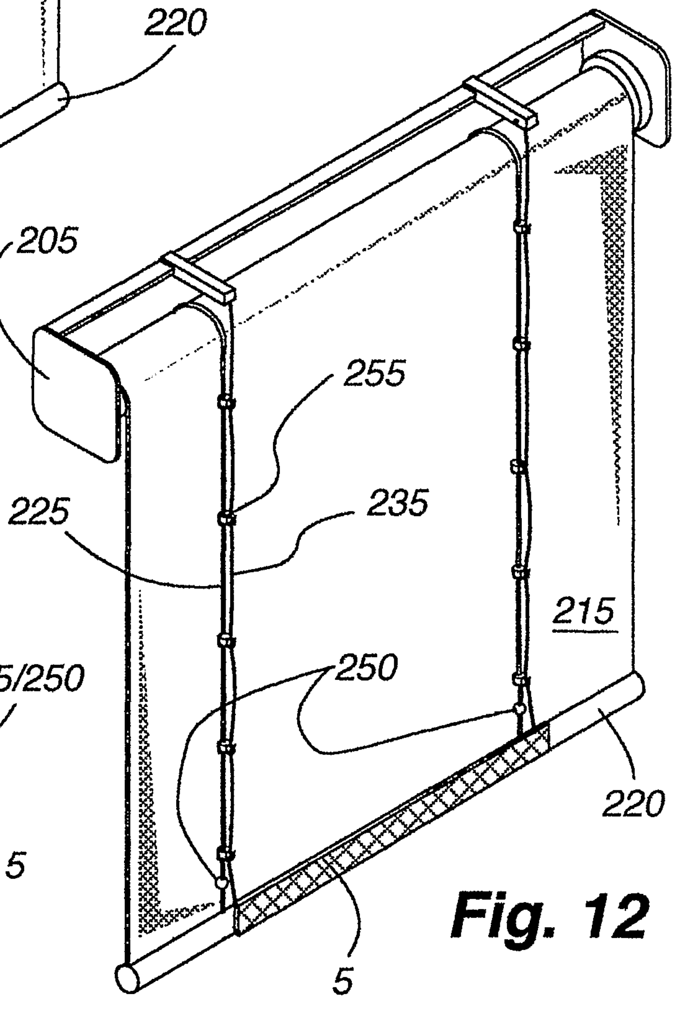

Fig. 12

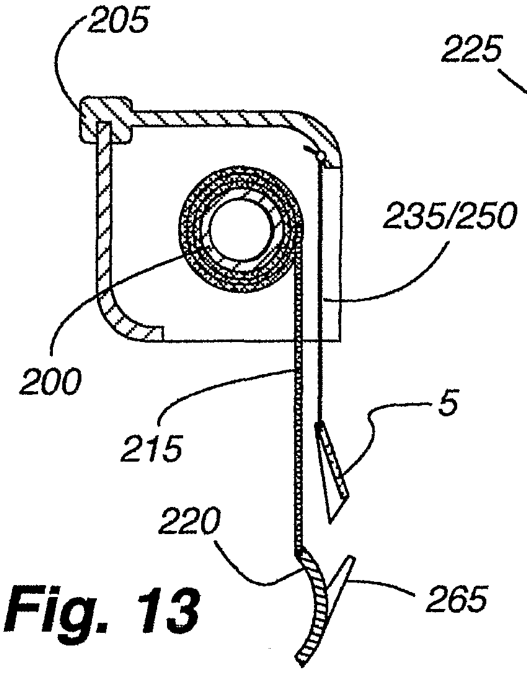

Fig. 13

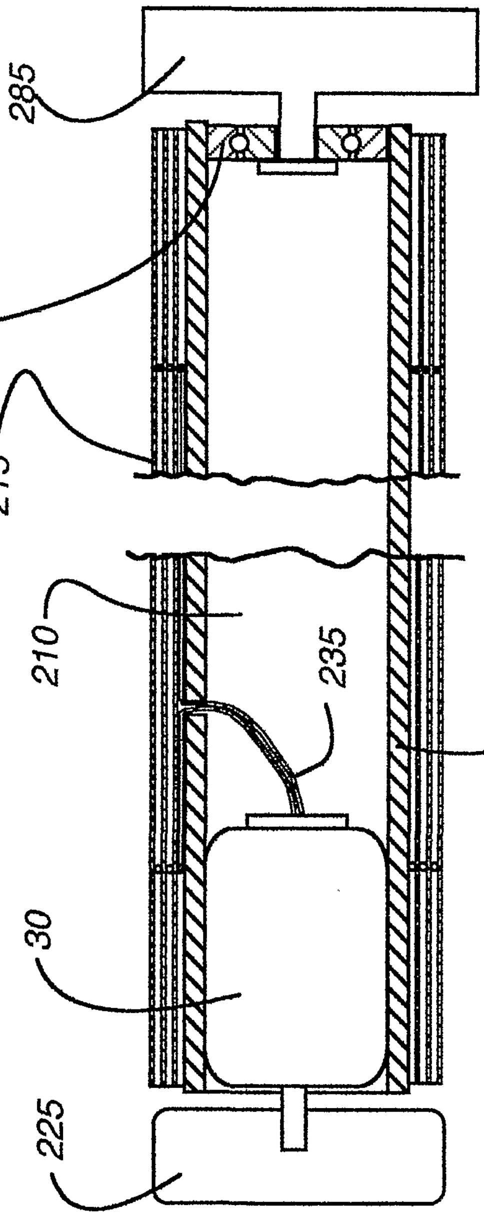

Fig. 15

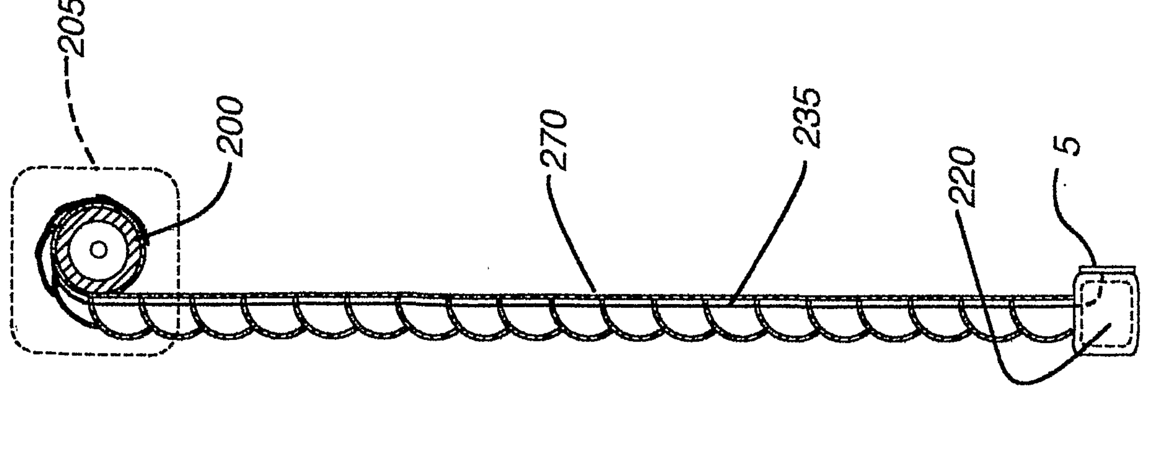

Fig. 14

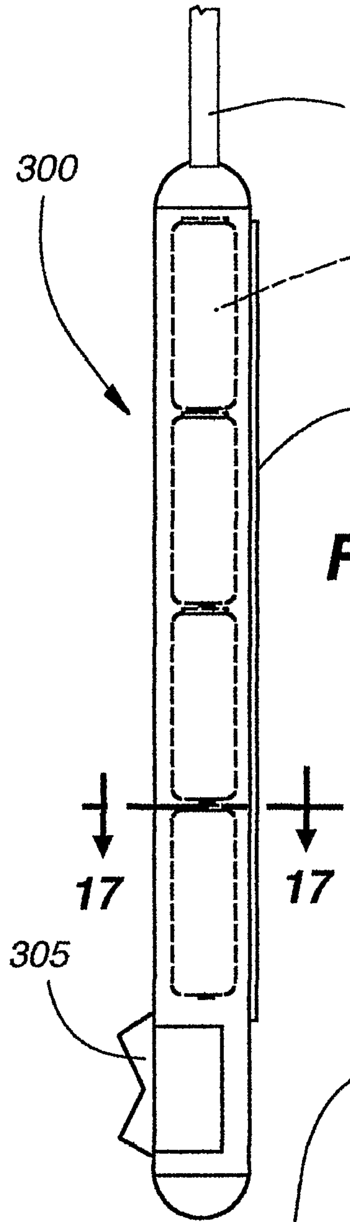

Fig. 16

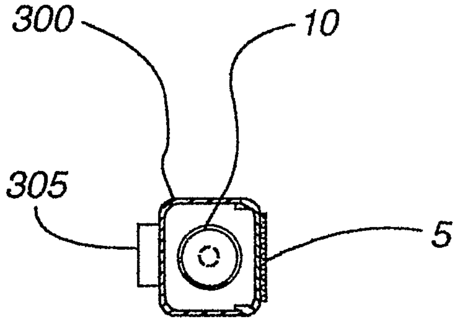

Fig. 17

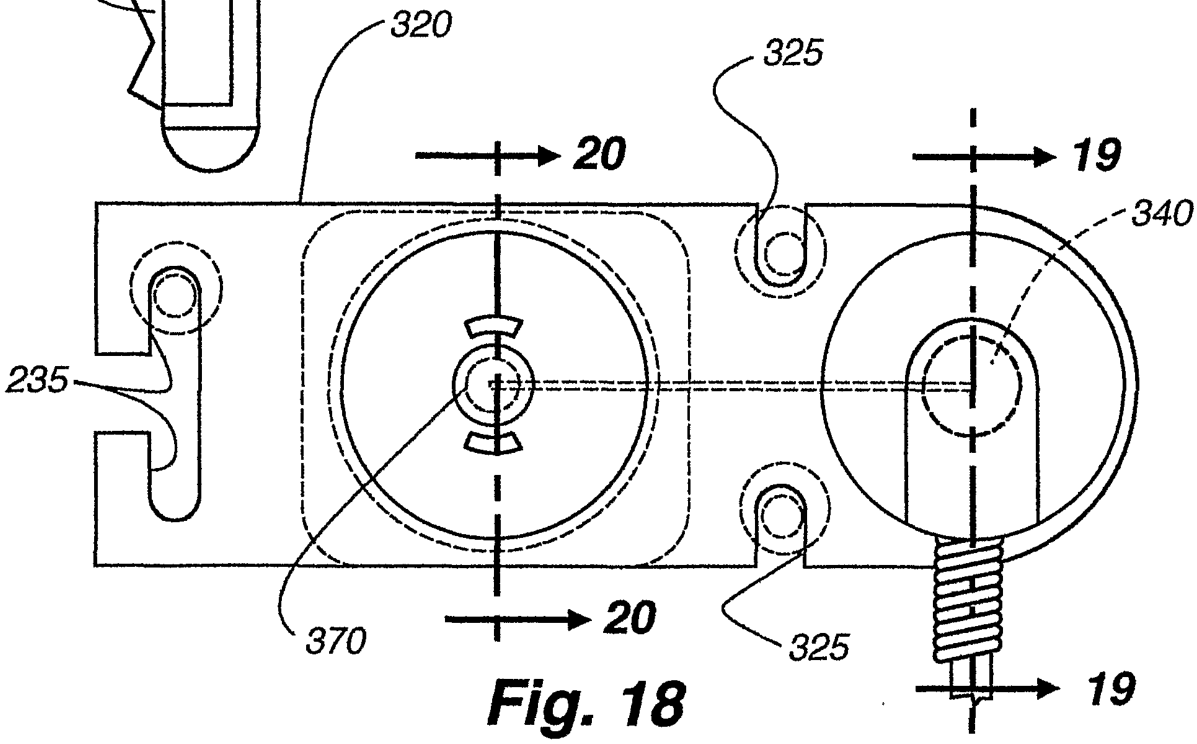

Fig. 18

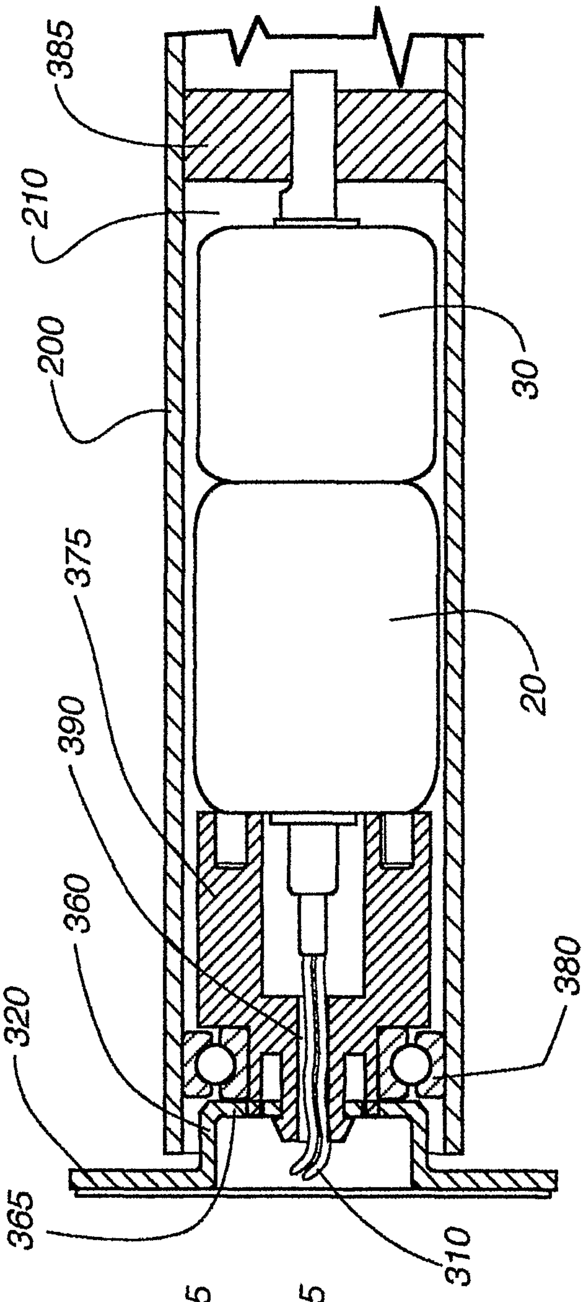
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Fig. 20

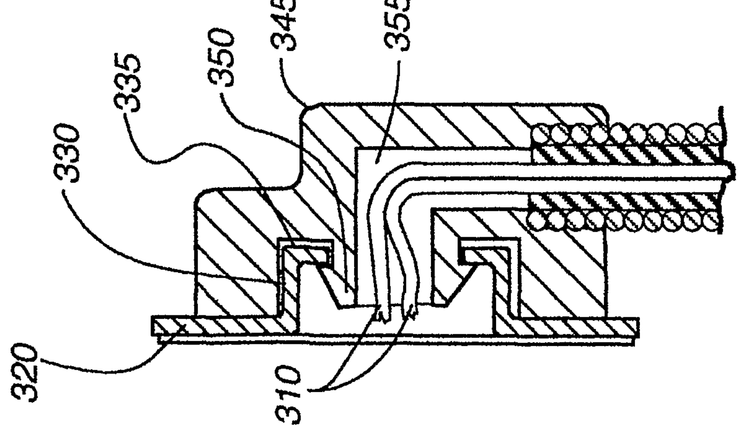
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Fig. 19

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/20331

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :A47G 5/02
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 160/310, 238, 133, 168.1R, DIG. 17, 7, 176.1, 188; 320/101; 318/480; 364/167.01

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,675,487 A (PATTERSON et al) 07 October 1997, entire document	1-73
X	US 5,760,558 A (POPAT) 02 June 1998, entire document	1-73
X	US 5,959,432 A (SAURER et al) 28 September 1999, entire document	74-81

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:
"A"	document defining the general state of the art which is not considered to be of particular relevance
"E"	earlier document published on or after the international filing date
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O"	document referring to an oral disclosure, use, exhibition or other means
"P"	document published prior to the international filing date but later than the priority date claimed
"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&"	document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 SEPTEMBER 2001	02 NOV 2001

Name and mailing address of the ISA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	BRUCE A. LEV Diane Smith f
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INTERNATIONAL SEARCH REPORT	International application No. PCT/US01/20331

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

160/310, 238, 133, 168.1R, DIG. 17, 7, 176.1, 188; 320/101; 318/480; 364/167.01