Title: METHOD AND APPARATUS FOR LINKED HORIZONTAL DRAPERY PANELS HAVING VARYING CHARACTERISTICS TO BE MOVED INDEPENDENTLY BY A COMMON DRIVE SYSTEM

Abstract: A curtain assembly comprises a rotatable drive element wherein at least one helical guide structure is formed on, or into, the outer surface of the drive element. A drive attachment element having a structure that communicates with the helical guide structure to move the drive attachment element axially along the drive element when the drive element is rotated. Specific embodiments incorporate either a manual or motor-driven rotation assembly for rotating the drive element. Further specific embodiments involve a helical guide structure that comprises a helical groove and a structure that comprises a tooth that engages with the helical groove. Further specific embodiments relate to a system with linked horizontal drapery panels having varying characteristics that are moved independently by a common drive system.
DESCRIPTION

METHOD AND APPARATUS FOR LINKED HORIZONTAL DRAPERY PANELS HAVING VARYING CHARACTERISTICS TO BE MOVED INDEPENDENTLY BY A COMMON DRIVE SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit of U.S. Patent Application Serial No. 13/843,617, filed March 15, 2013, which claims the benefit of U.S. Provisional Patent Application Serial No. 61/702,093, filed September 17, 2012, both of which are hereby incorporated by reference herein in their entirety, including any figures, tables, or drawings.

FIELD OF THE INVENTION

Embodiments of the present invention relate generally to a window covering assembly used to cover windows. Specific embodiments of the invention relate to a window covering assembly with a rotatable drive element that has a structure formed into or on the outer surface of the rotatable drive element such that a window covering moves axially along the rotatable drive element when the rotatable drive element rotates. Further specific embodiments relate to a window covering assembly in which two different curtains are operated by the same rotating drive element such that the user is able to independently move each curtain. Further specific embodiments relate to a system with linked horizontal drapery panels having various characteristics that are moved independently by a common drive system.

BACKGROUND OF THE INVENTION

Window coverings, such as curtains, are frequently used to provide privacy and to limit the amount of light that is permitted to pass through a window and into a room.

There are numerous types of window coverings known in the art. Curtains can be composed of panel(s) of fabric. For example, a curtain may be a single panel curtain that opens and closes from left to right. There is also a center closing curtain that is composed of two fabric panels that meet in the center of the window to close and cover the window.

Many different types of fabrics may be used depending on the user's needs and preferences. For example, sometimes it is necessary not only to cover but to also fully
blackout the window such that no light passes through. In this instance, a blackout curtain composed of opaque fabric that completely darkens the window may be useful. There may also be other situations, however, where some light is desired and some visibility is desired. A sheer curtain composed of a translucent fabric may be useful in this instance.

The curtain panels are attached to and suspended from a transverse curtain rod that is hung above the window. The panels are usually joined to the curtain rod by hooks or rings. The curtains are able to be moved manually across the curtain rod(s) as desired by a pull rod or the like to either cover or uncover the window.

There are various mechanisms, both electrical and manual, to mechanically move a curtain back and forth across an opening. Typical designs use a curtain guide track where the curtains are suspended. Some curtain assemblies use a series of pulleys, cables, and belts to move the curtain. In some cases these mechanisms are motorized. In these cases, the number of components used adds complexity to the assembly and also increases the cost of the assembly.

A sheer curtain is often hung with a blackout curtain on the same window to accommodate different preferences for light and visibility at different times. For example, a blackout curtain may be used to block out unwanted early morning sun. The blackout curtain may then be opened to allow the sun to filter through the sheer curtain later in the day. When a blackout curtain is hung with a sheer curtain, utility bills may also be lowered by using the different curtains to keep a home cool or warm, depending on the weather.

Hanging two different curtains, however, requires the installation of two different curtain guide tracks, one guide track for each curtain. If two curtains are hung from the same curtain guide track, there is not the ability to move one curtain without moving the other curtain and it prevents both curtains from being in the deployed position simultaneously.

U.S. patent 4,131,831 (Bochenek et al.) teaches a drapery opening and closing system for draw draperies which are movable over a traverse member between an open and closed position by use of a drapery drive system. The opening and closing system has limit switches positioned to be activated when the draperies are opened and closed. A manually settable timer connected to a power source applies power at preset times to a reversible motor via a control circuit. The control circuit is comprised of a relay activated by the timer and a series connected two-section switch. Outputs of the two-section switch are connected to the reversible motor through the limit switches. When the timer is triggered at a preset time, the
draperies automatically open or closes. Via the two-section switch, the draperies may be manually activated to open or close at times other than the preset times on the timer.

U.S. patent 4,492,262 (Comeau) teaches a telescoping drapery traverse rod with a motor drive without sacrificing any of the simple consumer installation and adjustment features of conventional draw-cord operated traverse rods. It employs a positive-drive perforated-plastic tape and sprocket combination with the tape being releasably secured to the master carriers in a manner analogous to that of the conventional draw cord arrangement.

U.S. 4,773,464 (Kobayashi) teaches an actuator for actuating a vertical blind or curtain of electric type to be mounted on a mounting support face. The actuator is enabled to eliminate the deformations such as torsions of rotating rods thereto to ensure their rotations by driving the two ends of each of the rotating rods with the torques of a pair of motors. The tension to be applied to a traverse rod can be easily adjusted to an appropriate value by fastening a nut on a tensing threaded rod connected to the traverse rod to tense the traverse rod. Rotation transmitting unit can be held in position in a pivotal state even if the tension is applied to the traverse rod. Since the traverse rod is fitted in a bearing by the face contact between ridges and corners, moreover, the rotating torque is dispersed to enhance the breaking stress at the fitted connection.

U.S. 4,827,199 (Kaucic et al.) teaches a traverse rod having a reversible torque responsive motor-drive assembly for operating the traverse rod. The motor-drive assembly includes a stationary casing fixed to the rod and a movable casing mounted in the stationary casing for angular movement relative thereto about a turn axis. A reversible DC motor in the movable casing is connected through a planetary gear speed reducer to a traverse cord drive wheel for applying driving torque thereto. The movable casing is arranged to turn about the turn axis in opposition to the torque applied to the drive wheel and is yieldable urged angularly about the turn axis toward a preselected neutral position relative to the stationary casing. The motor-drive assembly has a torque responsive motor control including stationary brush contacts fixed on the stationary casing and adapted for connection to a power supply and movable electrically conductive segments fixed on the movable casing and electrically connected to the motor. The movable electrically conductive segments include primary segments arranged to engage the brush contacts when the movable casing is in the neutral position and auxiliary segments spaced angularly about the turn axis from the primary segment to engage the brush contacts when the movable casing is turned through a preselected angle in either direction from the neutral position.
U.S. 4,878,528 (Kobayashi) teaches an electric blind of the type, in which a traverse
rod drive motor, a tilt rod drive motor and their drive transmitting means are arranged at one
end side of a casing frame so that the casing frame can be easily cut at the other end side
without removing those motors and the drive transmitting means to leave a new casing from
of a desired length. The traverse rod and the tilt rod can be cut together with the casing frame
to improve the workability of the electric blind. This blind has its slats offset from the center
line of the casing frame so that a shield cover can be extended to below the casing frame to
prevent the light from breaking therethrough. In this blind, moreover, the positions of the
clamping portions of brackets for supporting the two sides of the casing frame can be
adjusted independently of one another so that the blind can be mounted on the wall or the like
without any difficulty.

U.S. 5,301,733 (Toti) teaches a cover system suitable for windows including a tape
support for maintaining the orientation of the cover and for opening and closing the cover.

U.S. 5,467,808 (Bell) teaches an automatic blind or curtain suspension system
comprising a blind headrail 10 or curtain pole carrying at least one suspension device 28
arranged for movement relative to the headrail 10 or pole towards and away from a stop 48 to
open and close the blind or curtain. An electric motor 44a is coupled to the suspension device
28 and operable to cause it to move relative to the headrail 10 or pole. The system includes
compression springs 50 adapted to take up additional drive from the motor once motion of
the suspension device 28 is retarded by the stop 48. An automatic controller 12 is provided
which detects a monotonic increase in current to the motor 44a associated with drive from the
motor 44a being taken up by the springs 50 and interrupts current to the electric motor 44a
when the increase in motor current is detected. The controller may also keep track of the
position of the suspension device 28 and store its position when the increase in current is
detected. Drive to the electric motor 44a during subsequent operation of the system may then
be regulated in dependence upon the stored value to interrupt current to the motor before the
suspension device 28 hits the stop 48 again.

U.S. 6,152,205 (Toti) teaches window cover systems including window cover
material in the form of pleated panels or slats. The window cover material is suspended from
a traverse track and is traversed along the track for opening and closing the window system.
Arrangements for maintaining spacing and alignment of pleats or slats are provided. The
alignment maintaining arrangements include traverse tapes which are substantially rigid in
longitudinal and lateral directions in the plane of the tape, and are flexible in a direction
perpendicular to the tape. The arrangements also include attaching the window cover material to vertical edge members and providing foldable spacer-members between adjacent edge-members. In one arrangement, a box-pleated panel of window cover fabric is suspended from a traverse track on slide-members. The slide-members are each attached to a spacer-tape at regular intervals along the spacer-tape. The spacer-tape is substantially rigid in the traverse direction and in a vertical direction perpendicular to the traverse direction. The window cover system is opened and closed by rolling and unrolling the panel and the spacer-tape around a roller located at one end of a window frame. Other arrangements include combined, tape-supported vertical slat blinds and vertical pleated draperies in which the tape(s) are supported by sprockets or wheels/pulleys.

U.S. 6,533,017 (Toti) teaches window cover systems including window cover material in the form of pleated panels or slats. The window cover material is suspended from a traverse track and is traversed along the track for opening and closing the window system. Arrangements for maintaining spacing and alignment of pleats or slats are provided. The alignment maintaining arrangements include traverse tapes which are substantially rigid in longitudinal and lateral directions in the plane of the tape, and are flexible in a direction perpendicular to the tape. The arrangements also include attaching the window cover material to vertical edge members and providing foldable spacer-members between adjacent edge-members. In one arrangement, a box-pleated panel of window cover fabric is suspended from a traverse track on slide-members. The slide-members are each attached to a spacer-tape at regular intervals along the spacer-tape. The spacer-tape is substantially rigid in the traverse direction and in a vertical direction perpendicular to the traverse direction. The window cover system is opened and closed by rolling and unrolling the panel and the spacer-tape around a roller located at one end of a window frame. Other arrangements include combined, tape-supported vertical slat blinds and vertical pleated draperies in which the tape(s) are supported by sprockets or wheels/pulleys.

U.S. patent 7,222,655 (Toti) teaches window cover systems include window cover material in the form of pleated panels or slats. The window cover material is suspended from a traverse track and is traversed along the track for opening and closing the window system. Arrangements for maintaining spacing and alignment of pleats or slats are provided. The alignment maintaining arrangements include traverse tapes which are substantially rigid in longitudinal and lateral directions in the plane of the tape, and are flexible in a direction perpendicular to the tape. The arrangements also include attaching the window cover material
to vertical edge members and providing foldable spacer-members between adjacent edge-
members. In one arrangement, a box-pleated panel of window cover fabric is suspended from
a traverse track on slide-members. The slide-members are each attached to a spacer-tape at
regular intervals along the spacer-tape. The spacer-tape is substantially rigid in the traverse
direction and in a vertical direction perpendicular to the traverse direction. The window cover
system is opened and closed by rolling and unrolling the panel and the spacer-tape around a
roller located at one end of a window frame. Other arrangements include combined, tape-
supported vertical slat blinds and vertical pleated draperies in which the tape(s) are supported
by sprockets or wheels/pulleys. Therefore, it would be advantageous to have a simple curtain
assembly that will move a curtain from the deployed position to the stored position with the
minimum number of components that can be motorized as well as manually operated. It
would further be advantageous to have a dual curtain assembly that will move two separate
curtains.

SUMMARY OF THE INVENTION

Embodiments of the present invention relate to a window covering assembly. For
convenience, various embodiments will be described with respect to curtains with the
understanding that the description applies to other window coverings as well. Embodiments
of the curtain assembly include a drive element wherein at least one guide structure is formed
on or into the outer surface of the drive element; a drive attachment element having a
corresponding structure that communicates with the at least one guide structure to move the
drive attachment element axially along the drive element when the drive element is rotated;
and a rotation assembly for rotating the drive element. In some embodiments of the
invention, the guide structure forms a helical pattern on the rotatable drive element and the
corresponding structure is a tooth that is moved by the groove when the drive element is
rotated. The guide structure can also be a ridge or other structure that can cause the
corresponding structure to move axially along the drive element when the drive rotates.
In specific embodiments the drive element can be a tube.

In specific embodiments according to the present invention, the curtain assembly
includes a rotatable drive element having a clockwise helical guide structure and a counter
clockwise helical guide structure formed on, or into, the outer surface of the drive element; a
first drive attachment element having a structure that communicates with the clockwise
helical guide structure to move the first drive attachment element axially along the drive
element when the drive element is rotated; and a second drive attachment element having a
structure that communicates with the counterclockwise helical guide structure to move the
second drive attachment element axially along the drive element when the drive element is
rotated; and a rotation assembly for rotating the drive element.

In accordance with some embodiments of the present invention, a dual curtain
assembly is provided. A specific embodiment of dual curtain assembly includes a rotatable
drive element having at least one guide structure formed on, or into, the outer surface of the
drive element; at least two drive attachment elements having a corresponding at least two
structures that communicate with the at least one guide structure to move the at least two
drive attachment elements axially along the drive element when the drive tube is rotated
Further specific embodiments can also incorporate a rotation assembly for rotating the drive
element. The rotation assembly can be manual or motorized.

In accordance with some embodiments of the invention, a dual curtain assembly
includes a drive element having at least one guide structure formed on, or into, the outer
surface of the drive element; at least one outer drive attachment element having a

In accordance with yet other embodiments of the invention, applicable, for example,
to a center closing curtain system, the curtain assembly may include a drive element having at
least one guide structure formed on, or into, the outer surface of the drive element; a left outer
drive attachment element having a corresponding left outer structure that communicates with
the at least one guide structure to move the left outer drive attachment element axially along the
drive element when the drive element rotates; a right outer drive attachment element
having a right outer structure that communicates with the at least one guide structure to move
the right outer drive attachment element axially along the drive element when the drive
element rotates; a left inner drive attachment element having a corresponding left inner
structure that communicates with the at least one guide structure to move the left inner drive
attachment element axially along the drive element when the drive element is rotated; a right
inner drive attachment element having a corresponding right inner structure that
communicates with the at least one guide structure to move the right inner drive attachment
element axially along the drive element when the drive element is rotated; and a rotation
assembly for rotating the drive element, wherein the rotation of the drive element moves the
left and right outer drive attachment elements axially along the drive element when the drive
element is rotated and independently moves the left and right inner drive attachment elements
along the drive element when the drive element is rotated.

These features and aspects of the invention as well as its advantages are understood
by referring to the following description, appended claims, and accompanying drawings, in
which:

FIG. 1 is a perspective view of one embodiment of the curtain assembly showing a
curtain in the deployed position and the window is covered.

FIG. 2 is a perspective view of one embodiment of the curtain assembly showing the
curtain in the stored position and the window is not covered.

FIG. 3 is a perspective view of one embodiment of the curtain assembly showing a
left hand curtain in the stored position.

FIG. 4 is an enlarged perspective view of one embodiment of the curtain assembly
showing a center closing curtain in the deployed position covering the window.

FIG. 5 is an enlarged perspective view of the components of the rotatable drive
element according to one embodiment of the curtain assembly in which the rotation of the
drive element is powered by a battery operated motor.

FIG. 6 is an enlarged perspective view of the components of the rotatable drive
element according to one embodiment of the curtain assembly in which the power supply to
the motor is external to the drive element.

FIG. 7 is an enlarged perspective view of one embodiment of the curtain assembly
showing the rotatable drive element with a clockwise helical groove.

FIG. 8 is an enlarged perspective view of one embodiment of the curtain assembly
showing the rotatable drive element with a counter clockwise helical groove.

FIG. 9 is an enlarged perspective view of one embodiment of the curtain assembly
showing the rotatable drive element with a clockwise helical groove and a counter clockwise
helical groove.

FIG. 10 is an enlarged perspective view of the drive attachment element according to
one embodiment.
FIG. 11 is an enlarged side view of the drive attachment element 36 showing the structure 62 as a tooth according to one embodiment.

FIG. 12 is an enlarged cross-sectional view of the drive attachment element 36 showing the angle of the drive tooth 62 according to one embodiment.

FIG. 13 is an enlarged perspective view of the drive attachment element having a first drive tooth and a second drive tooth according to one embodiment.

FIG. 14 is an enlarged side view of the drive attachment element 36 having a first drive tooth and a second drive tooth according to one embodiment.

FIG. 15 is an enlarged cross-sectional view of the drive attachment element 36 showing the angle of the second drive tooth 90 according to one embodiment.

FIG. 16 is an enlarged cross-sectional view of the drive attachment element 36 showing the angle of the first drive tooth 88 according to one embodiment.

FIG. 17 is a section view of the tube 26 and the drive attachment element 36 showing the engagement of the first drive tooth 88 in the first helical groove 38.

FIG. 18 is an enlarged end view of a motor drive adapter according to one embodiment of the curtain assembly.

FIG. 19 is an enlarged perspective view of a motor drive adapter according to one embodiment of the curtain assembly.

FIG. 20 is an enlarged perspective view of the rotatable drive element according to one embodiment.

FIG. 21 is an enlarged end view of the rotatable drive element according to one embodiment.

FIG. 22 is an enlarged perspective view of the preferred tube embodiment with the position a section was taken to reflect the two clockwise helical grooves 38 and two counter clockwise grooves 40 in the tube 26.

FIG. 23 is an end view of the drive element assembly of the preferred embodiment showing the starting points of the clockwise helical grooves 38 and the counter clockwise grooves 40.

FIG. 24 is the cross section view taken from FIG. 22.

FIG. 25 is the preferred embodiment curtain assembly.

FIG. 26 is a drawing of the functional relationship of the helical grooves 38 and 40 to the midpoint of the drive element to assure the drive attachment elements meet in the midpoint of the drive element on center close draperies.
FIG. 27 is a perspective view of one embodiment of the curtain assembly when the outer curtain is a blackout curtain in the deployed position and the inner curtain is a sheer curtain in the deployed position.

FIG. 28 is a perspective view of one embodiment of the curtain assembly when the outer curtain is a blackout curtain in the stored position and the inner curtain is a sheer curtain in the deployed position.

FIG. 29 is a perspective view of the embodiment of the curtain assembly when both the outer and inner curtains are in the stored position.

FIG. 30 is a perspective view of the preferred embodiment with the outer curtain is a blackout curtain with a portion cut away to show the position of the external battery pack from FIG. 6.

FIG. 31 is an enlarged perspective view of the components of the rotatable drive element according to one embodiment of the curtain assembly showing an internal battery power supply.

FIG. 32 is an enlarged perspective view of the components of the rotatable drive element according to one embodiment of the curtain assembly show an external power supply.

FIG. 33 is a cross-sectional view of the drive section of the rotatable drive element showing the helical groove and a non-driving groove according to one embodiment of the curtain assembly.

FIG. 34 is an enlarged perspective view of one embodiment of the curtain assembly non-driving groove.

FIG. 35 is an enlarged perspective view of one distal end of the rotatable drive element showing the inner drive attachment element and the inner driver stall area according to the same embodiment of the curtain assembly shown in FIG. 34.

FIG. 36 is an enlarged side view of the inner drive attachment element according to one embodiment of the curtain assembly.

FIG. 37 is an enlarged perspective view of the inner drive attachment element according to one embodiment of the curtain assembly.

FIG. 38 is an enlarged sectioned view of the inner drive attachment element according to one embodiment of the curtain assembly.

FIG. 39 is an enlarged side view of the inner drive attachment element according to one embodiment of the curtain assembly.
FIG. 40 is an enlarged perspective view of the inner drive attachment element according to one embodiment of the curtain assembly.

FIG. 41 is an enlarged sectioned view of the inner drive attachment element according to one embodiment of the curtain assembly.

FIG. 42 is an enlarged perspective view of an outer idler attachment element according to one embodiment of the curtain assembly.

FIG. 43 is an enlarged sectioned view of an outer idler attachment element according to one embodiment of the curtain assembly.

FIG. 44 is an enlarged side view of an outer idler attachment element according to one embodiment of the curtain assembly.

FIG. 45 is an enlarged side view of an outer drive attachment element according to one embodiment of the curtain assembly.

FIG. 46 is an enlarged sectioned view of an outer drive attachment element according to one embodiment of the curtain assembly.

FIG. 47 is an enlarged perspective view of an outer drive attachment element according to one embodiment of the curtain assembly.

FIG. 48 is an end view of the curtain assembly showing the guide track, guides, attachment elements, and the position of the inter-curtain engager.

FIG. 49 is a perspective view of a curtain assembly according to one embodiment when the outer curtains are center closing blackout curtains in the stored position and the inner curtains are center closing sheer curtains in the deployed position.

FIG. 50 is a perspective view of a curtain assembly according to one embodiment when the outer curtains are center closing blackout curtains in the deployed position and the inner curtains are center closing sheer curtains in the stored position.

FIG. 51 is a perspective view of the tube end with the inner driver stall area.

FIG. 52 is a top view of the curtain assembly with the guide track removed to see the position of the guides and attachment elements with the inner and outer curtains deployed and the outer drive attachment element can stop the tube from rotation when it stalls against the inner attachment element in the stall area.

FIG. 53 is a top view of the curtain assembly with the guide track removed to see the position of the guides and attachment elements with the inner curtains deployed and the inter-curtain engager is in the engage-outer-drive-attachment-element position and the inner drive attachment element is in the stall area.
FIG. 54 is a top view of the curtain assembly with the guide track removed to see the position of the guides and attachment elements with the inner and outer curtains in the stored position and the outer simple attachment elements and the outer drive attachment element are in the non-driving or stall area. The inner curtain drive attachment element can stop the tube from rotation when it contacts the outer curtain drive attachment element.

FIG. 55 is a perspective view of the area where the outer attachments are stored with the tube, inner and outer curtains removed to show the position of the inter-curtain engager and the carrier tracks.

FIG. 56 is a perspective view of the inner curtain carrier and S-hook.

FIG. 57 is a perspective view of the inner curtain carrier with the inner curtain engager.

Fig 58 is three views of the preferred tube embodiment with an outer driver stall area and two helical grooves spaced 180 degrees apart.

FIG. 59 is another tube embodiment with four helical grooves, two are counter clockwise spaced 180 degrees apart and two are clockwise spaced 180 degrees apart.

FIG. 60 is another embodiment of a tri-lobed tube, drive element, and internal tube driver.

FIG. 61 shows four views of the inner curtain carrier and S-hook.

FIG. 62 shows four views of the inter-curtain engager.

FIGS. 63A-63L show flowcharts for the control system for specific embodiments of the invention.

FIG. 64 shows a perspective view of the drapery movement assembly in accordance with an embodiment of the invention, without the draperies.

FIG. 65 shows a front or plan view of the assembly of Figure 64.

FIG. 66 shows an end or side view of the assembly of Figure 64.

FIG. 67 shows an end view of the assembly of Figure 64 with the end plate 112 removed.

FIG. 68 shows a bottom-up perspective view of the assembly of Figure 64.

FIG. 69 shows a section view of the center mounting of the drive elements 114 and 115.

FIG. 70 shows a top view of the inner curtain driver 123 with a portion of the cover track 111 cut away showing the swivel magnet 124 and stationary magnet 135 having the
same poles proximate to and repelling each other and the outer driver 121 physically separation the magnets 124 and 135.

FIG. 71 shows a top view of the inner curtain driver 123 with a portion of the cover track 111 cut away showing the inner driver 123 disengaged from the outer driver element 121 allowing the drapery to be moved by hand.

FIG. 72 shows a top view of the inner curtain driver 123 with a portion of the cover track 111 cut away showing the swivel magnet 124 and stationary magnet 135 having opposite poles proximate to and attracting each other.

FIG. 73 shows a top view of the inner curtain driver 123 with a portion of the cover track 111 cut away showing the magnets 124 and 135 no longer attached and the outer driver 121 engaged with the inner curtain driver 123.

FIG. 74 shows a top view of the inner curtain driver 123 with a larger portion of the cover track 111 cut away showing the swivel magnet 124 and stationary magnet 135 having opposite poles proximate to and attracting each other, the outer driver 121 engaged with the drapery driven hanger 117 and the inner curtain driver hanger 116.

FIG. 75 shows a section view taken from the area where the outer driver 121 is engaged with the drive element 114.

FIG. 76 shows an exploded parts view of the assembly of Figure 64.

FIG. 77 shows an enlarged view of the center mounting components of Figure 76.

DETAILED DESCRIPTION

Referring to FIG. 1, a curtain assembly 20 according to one embodiment of the invention is shown. The curtain assembly 20 comprises a rotatable drive element 22 wherein a helical guide structure 24 is formed into the outer surface 26 of the drive element 22, a drive attachment element 36 having a corresponding structure 62 that communicates with the helical guide structure 24 to move the drive attachment element 36 axially along the drive element 22 when the drive element 22 is rotated and a rotation assembly 32 (not shown) for rotating the drive element 22. In some embodiments of the invention, the helical guide structure 24 is a helical groove 24 and the corresponding structure 62 is a tooth. While the helical guide structure 24 is shown in FIGS. 1-3 as a helical groove, the helical guide structure 24 is not limited to a groove. Similarly, the corresponding structure 36 discussed in the embodiments below is a tooth 62 but is not limited to being a tooth. In some embodiments, one or more curtain supports 67 supported by the rotatable drive element 22
can also be utilized to support the curtain. The drive attachment element 36, as shown in FIGS. 1-3 will be explained further below.

Description of Curtains

As shown in FIG. 1, the curtain 44 used is composed of a single continuous panel of fabric that moves back and forth across the drive element 22 to the deployed position (covering the window) and to the stored position (not covering the window 34). The curtain 44 may extend to the right to the deployed position (covering the window 34) and then gather to the left to the stored position, uncovering the window 34. This is shown in FIGS. 1 and 2. For example, FIG. 1 shows that a curtain 44 extended to the right (deployed position) to cover the window 34 and FIG. 2 shows the curtain 44 gathered to the left (stored position) to uncover the window 34. In other embodiments, the curtain 44 may extend to the left to the deployed position (covering the window 34) and then gather to the right to the stored position (uncovering the window 34). For example, FIG. 3 shows a curtain assembly 20 wherein the curtain 44 is gathered to the right (stored position) to uncover the window 34. Although not shown, the curtain 44 in FIG. 3 would extend to the left to the deployed position to cover the window 34.

Again, although curtain is used to describe a preferred embodiment of the invention, other embodiments utilize other window coverings, such as verticals and draperies.

In some embodiments, the curtain 44 may be a center closing curtain 46. A center closing curtain 46 is composed of two fabric panels, a right panel 50 and a left panel 48 that meet in the center 42 of the window 34 to close and cover the window 34. FIG. 4 shows a curtain assembly 20 where a center closing curtain 46 is used and is in the deployed position. The window 34 is covered in this instance. For example, the right panel 50 extends to the left to the center of the window 42. The left panel 48 extends to the right to the center of the window 42.

Drive Element

The curtain assembly 20 includes a drive element 22. FIGS. 5 and 6 show one embodiment of the drive element 22 in detail. A curtain 44 can be connected to the drive element 22 by one or more curtain supports 36 and 67 as explained below. Alternatively, at least a portion of the curtain can be supported by another structure adjacent to the rotatable drive element 22, such as a support guide (not shown).
The rotatable drive element 22 is designed to be installed above a window 34, or near the top of the window 34, similar to a traditional curtain rod. For example, as shown in FIG. 1, drive element 22 is mounted on axles 52 that are located and secured in the end brackets 54. The end brackets 54 are adapted for connection with, for example, a window frame, sash, or wall. The end brackets 54 may also include a rubber mounting disk 13, not shown, that is compressed, and, optionally, inserted into a fmial 95 or other structure to create friction, when the drive element 22 is installed, to hold the drive element 22 firmly in place and minimize noise.

The drive element 22 may vary in size. For example, the drive element 22 may be the width of the window 34, narrower than the window 34, or wider than the window 34. The outer diameter 56 of the drive element 22 may similarly vary. In specific embodiments, the drive element has an outer diameter of the drive element that is 1 inch, 1 ¼ inches, 1 ½ inches, 2 inches, 1-2 inches, 1-1 ½ inches, 1 ½ - 2 inches, less than 1 inch, and/or greater than 2 inches. In some embodiments, the drive element 22 has a hollow portion that is sized to mount a motor 82 inside the hollow portion of the drive element 22 rather than mounting the motor 82 outside the drive element 22. Using the inside of the drive element 22 to conceal the motor 82 may give a more aesthetically pleasing design for a curtain assembly 20. Any number of materials, such as aluminum, other metals or alloys, plastics, wood, and ceramics, may be used to fabricate the drive element 22 provided the drive element 22 can support the weight of the curtain 44.

Although the FIGS. 5 and 6 show the outer surface of the drive element 22 as cylindrical in shape, the cross-sectional shape of the drive element 22 is not limited and may be non-circular. In an alternative embodiment, as shown in FIGS. 20 and 21, the rotatable drive element 22 may be tri-lobed.

Guide Structure

The drive element 22 has at least one guide structure 24 formed, for example, on, or into, the outer surface 26 of the drive element 22. For convenience, as a preferred embodiment employs a one or more helical guide structure, it is understood that descriptions of embodiments of the invention having helical guide structures also applies to embodiments having guide structures with other patterns. A preferred guide structure 24 is a helical guide structure 24. Such a guide structure may be a groove in some embodiments, as shown in FIGS. 7-9. The helical guide structure 24, however, is not limited to being a helical groove.
For example, the guide structure 24 may be a ridge, protrusion, or other structure that can communicate with the corresponding structure of the drive attachment element to axially move the drive attachment element along the drive element when the drive element is rotated.

The helical groove 24 can extend along a portion of, or the entirety of, the drive element 22. In a preferred embodiment, the helical groove extends from one distal end portion, referred to as the motor end 58, to the opposing distal end portion, referred to as the bearings end 59, of the drive element 22. Alternatively, the helical guide structure 24 can begin and end at any desired point along the longitudinal axis of the drive element 22, and/or stop and start over various portions of the drive element, depending on the application. The length of the helical groove 24 is a factor in determining how far a curtain 44 will travel across the drive element, i.e., the entire length of the drive element 22 as opposed to some shorter section of the drive element 22. The angle of the helical groove determines how far the drive attachment element will move along the drive element for a given amount of rotation of the drive element.

In an embodiment, the helical groove 24 is formed in either a clockwise direction or a counterclockwise direction. FIG. 7 illustrates a drive element 22 having a counterclockwise helical groove 38. FIG. 8 illustrates a drive element 22 having a clockwise helical groove 40.

In one embodiment, the drive element 22 has two helical grooves 24, one formed in the clockwise direction and one formed in the counterclockwise direction. FIG. 9 illustrates a drive element 22 in which there are a counter clockwise helical groove 38 and a clockwise helical groove 40. In yet other embodiments, the drive element 22 may have four helical grooves, two clockwise helical grooves 38 and two counter clockwise helical grooves 40 as shown in FIGS. 22-24.

When two clockwise helical grooves 38 or two counter-clockwise helical grooves 40 are utilized, the two clockwise helical grooves 38, or the two counter-clockwise helical grooves 40 are preferably spaced approximately 180 degrees apart. Other spacings can also be utilized. The clockwise helical grooves 38 and the counterclockwise helical grooves 40 preferably form the same angle with the longitudinal axis. The profile of the helical grooves 38, 40 can be self-centering to allow the drive tooth 62 to traverse the intersection of the clockwise helical groove 38 and the counter clockwise helical groove 40 without binding. A beveled groove, which allows such self-centering, is shown in FIG 17.

The helical grooves 24 may be formed by forming grooves into the outer surface 26 of the drive element 22 such that the grooves 24 are recessed from the outer surface 26 of the
drive element 22. Alternatively, the helical guide structures 24 may be formed as one or more protrusions that project or bulge from the outer surface 26 of the drive element 22. The protrusions may be formed in a variety of manners, for example, by winding material around the outer surface 26 of the drive element 22, forming, e.g., extruding the drive element in a manner that creates indentations in and/or projections from the outer surface of the drive element, or forming the drive element so as to have an outer surface able to apply a force in the longitudinal direction to a structure 62 of the corresponding drive attachment element 36 when the corresponding structure is engaged with the structure 24 upon rotation of the drive element about the longitudinal axis.

In an alternative embodiment, a sleeve, or outer tube 63, having helical guide structure 24 and sized to fit around a portion of the drive element 22 may be used. In this case, the drive sleeve has at least one helical groove 24 in a clockwise or counter clockwise direction formed on the outer surface of the sleeve. The sleeve/outer tube can be interconnected to an inner tube 61, or other inner drive element 9 (e.g., rod), that is rotated so as to cause the rotation of the sleeve/outer tube. The inner drive element 9 can provide sufficient stiffness to keep the sleeve from bending too much along the longitudinal axis of the sleeve from the weight of the curtains, so that the sleeve need not be sufficiently stiff to keep from bending too much along the longitudinal axis of the sleeve from the weight of the curtains. The drive element 22, which then comprises the inner drive element 9 and the outer tube or sleeve, again translates the torque from the rotation assembly to axially movement of the curtain support 67 or drive attachment element 36 across the drive element 22. In an embodiment, the drive sleeve is secured to the inner drive element to form the drive element 22 such that the sleeve does not slide up or down the inner drive element or rotate around the inner drive element 9. It may also be desired to remove the sleeve from the inner drive element 9 and replace it with another sleeve. Using a drive sleeve has the advantage that the geometry of the helical groove 24 including its length may be easily changed by removing the sleeve and replacing it without fabricating a new drive element 22.

The helical grooves 24 may also vary in angle and therefore, may differ in the amount of time (rotations of the drive element) that it takes to travel across the drive element 22. For example, a helical groove 24 with a larger angle, with respect to a plane through a cross-section of the drive element, may create a shorter path for the structure to travel and lead to a faster moving curtain 44 for a certain rotation speed of the drive element. In some embodiments, the angle of the helical grooves 24, with respect to a cross-sectional plane of
the drive element, may vary along the drive element in the direction of the longitudinal axis of the drive element 22 such that the curtain 44 may move at different speeds along the drive element 22, for a given rotational speed of the drive element, if desired. The angle of the helical groove 24, with respect to a cross-sectional plane of the drive element, varies from greater than 0 degrees and less than 90 degrees, preferably varies from 10 degrees to 80 degrees, more preferably varies from 20 degrees to 70 degrees, even more preferably varies from 30 degrees to 60 degrees, and is most preferably 45 degrees. Specific embodiments can have an angle of the helical groove in the range 30-45 degrees, 40-45 degrees, 40-50 degrees, 35-45 degrees, 42-48 degrees, or other angle that facilitates the desired speed of the curtain with respect to the rotation of the drive element and efficient transfer of force from drive element to drive attachment element.

Rotation Assembly

The drive element 22 can be connected to a rotation assembly 33 for rotating the drive element 22, where the rotation of the drive element 22 moves the drive attachment element 36 along the drive element via the helical groove 24 of the drive element 22.

The rotation assembly 33 may be a pull cord 72 connected to the drive element 22 or a motor assembly 32. The drive element 22 may be rotated manually. For example, a pull cord 72 as shown in FIGS. 1-3 may be connected to the drive element 22 such that the drive element 22 can be manipulated manually to rotate when it is desired to deploy or store the curtain 44. The use of pull cords 72 is well known in the art.

A motor assembly 32 may be used to rotate the drive element 22. The motor 82 may be mounted either inside or outside the drive element 22. In one embodiment, the motor 82 is mounted inside the drive element 22 and generally concealed from plain view. Components including axles 52 and bearings 94 may also be located inside the rotatable drive element 22.

A slip ring 28 may be used to transfer current from the power supply external to the drive element 22 to the motor 82 in the drive element 22 as shown in FIG. 6. Alternatively, batteries 84 in a battery tube 86 may be used as shown in FIG. 5 to power the motor 82. The batteries 84 in the battery tube 86 may be in a spring loaded sleeve to assist with loading and unloading the batteries 84 from the battery tube. In some embodiments, a motor drive adapter 92 as shown in FIG. 6 may also be used to securely attach or connect the motor 82 to the drive element 22. In other embodiments, the motor housing fits tightly against the drive element 22 and turns the drive element 22 when the motor output shaft is held in end bracket
54 to prevent it from turning. FIG. 5 shows the interconnection of end caps 51, axles 52, bearings 94, bearing housings 57 (note the bearing housing 57 is shown on the motor end in FIG. 5, but the bearing housing 57 on the battery end is not shown), motor 82, and battery tube 86. FIG. 6 shows a slip ring 28, which is optional, and allows the circuit to be completed while rotating.

In a motorized operation, the user may push a button 98 on a remote control 96 to turn on the motor 82 to rotate the drive element 22 such that the curtain 44 moves across the drive element 22 between a stored position and a deployed position depending on the user’s preference. The remote control 96 and button 98 are shown in FIGS. 1-3. In other embodiments, the motor 82 may respond to a signal from the remote control 96 that is initiated by a voice command to the remote control, which then causes the motor 82 to rotate the drive element 22.

The curtain assembly 20 may also include a remote control 96 having a control board that generates a signal when the user makes a selection on the remote control 96. The control board has a transmitter that can wirelessly communicate with a receiver that is remotely located from the transmitter. For example, the receiver may be located in the motor 82 in the drive element 22. The receiver receives the transmitted signal from the transmitter and transmits it to the motor 82, which will cause the motor 16 to turn on, rotate the drive element 22, and moves the curtain 44.

As the drive element rotates, either manually or by a motor 82, the curtain 44 is engaged on the drive element 22 and moves axially along the drive element 22 to either a deployed or stored position.

Curtain Support, Drive Attachment Element and Structure

The curtain assembly 20 can include a drive attachment element 36 having a structure 62 that communicates with the guide structure 24 to move the drive attachment element 36 axially along the drive element 22 when the drive element 22 is rotated. The curtain assembly can also include one or more idler attachment elements 67 that interconnect with the drive element to support the window covering, e.g. curtain. In specific embodiments, the drive attachment element 36 has a corresponding feature 62 that is a tooth 62 as described below.

The curtain assembly 20 of the present invention may include in some embodiments at least one drive attachment element 36 having a feature 62 that communicates with a helical
guide structure 24 to move the drive attachment element 36 axially along the drive element 22 when the drive element 22 is rotated. The helical guide structure may be a helical groove 24 and the feature 62 may be a tooth. Referring to Figure 1, one end, such as the motor end, of the curtain can be fixed 64 and the adjacent opposing end, such as the bearings end, of the curtain 66 can be attached to the drive attachment element 36. The feature 62 as a tooth is shown in FIGS. 10-12. FIG. 10 shows an enlarged perspective view of the drive attachment element 36. FIG. 11 is an enlarged side view of the drive attachment element 36 showing the drive tooth 62 according to one embodiment. FIG. 12 is an enlarged cross-sectional view of the drive attachment element 36 showing the angle a (approximately 30 degrees) of the drive tooth 67. This angle a is the same angle as the helical groove makes with respect to a cross-sectional plane of the drive element.

As shown in FIGS. 10-12, the drive attachment element 36 can be ring-shaped and slides over the drive element 22. A different construction, however, may be used for the drive attachment element 36. As an example, the drive attachment element may have one or more additional structures 62, which may follow a corresponding one or more additional grooves, and/or one or more of the structures 62 can be located at a different rotational position with respect to the longitudinal axis of the drive element when the structure is mounted onto the drive element. The drive attachment element 36 is preferably provided with a slot 99 into which a traditional curtain hook 37 can be used to connect the end of the curtain to the drive attachment element 36. Curtain pins and curtain rings that are well known in the art to hang curtains may be used.

The structure 62 is designed to communicate with or engage the helical groove 24 of the drive element to move the drive attachment element 36 axially along the drive element, thereby moving the curtain. In one embodiment, the feature is a tooth formed on an angle on the inner surface of the body of the drive attachment element. The angle a of the drive tooth 62 is specifically designed to engage the helical groove on the drive element 22. In an embodiment, a design consideration is to maximize the amount of contact between the rotating drive element 22 and the drive attachment element 36 to move the weight of the curtain. The location of the tooth 62 with respect to the drive attachment element 36, in some embodiments of the present invention, are adjustable such that the angle the location of the tooth makes with respect to the drive element when the drive attachment element is interconnected to the drive element is adjustable. This adjustability allows the user of the curtain assembly to set the correct location of the drive attachment element(s) 36 in
relationship to the axial position along the drive element for a particular rotational position of
the drive element, as where the tooth is positioned and where the helical groove is located for
a particular angular position of the drive element determines the axial position of the drive
attachment element and, therefore, the axial position of the point of the curtain attached to the
drive attachment element. In this way, if it is desired for a distal end of the curtain to reach
the distal end of the drive element at a particular degree of rotation of the drive element (e.g.,
720°, or 3600°), then the relative rotational position of the tooth to the drive attachment
element can be adjusted.

In some embodiments, the drive attachment element 36 has a first drive tooth 88 and a
second drive tooth 90 as shown in FIGS. 13-16. Both the first drive tooth 88 and the second
drive tooth 90 are configured to communicate with different helical grooves 24 of the drive
element 22. The first drive tooth 88 and the second drive tooth 90 are positioned inside the
drive attachment element 36 at the top and the bottom of the drive attachment element 36,
respectively. FIGS. 15 and 16 show cross-sectional views of the top and the bottom of the
drive attachment element 36 which show the angle $\alpha_1$ of the first drive tooth and the angle of
the second drive tooth $\alpha_2$. The angles $\alpha_1,\alpha_2$ are both 45 degrees. The angles $\alpha_1,\alpha_2$ of the first
drive tooth 88 and the second drive tooth 90 are not limited to 45 degrees and are configured
to communicate with the corresponding helical groove 24 of the drive element 22. In a
preferred embodiment, also shown in FIGS 22-26, there are four helical grooves 26. Two are
clockwise spirals 38 and two are counter-clockwise 40.

One issue with this type of helical pattern on center closing curtains is keeping the
timing of the drive attachment elements and the helical groove such that the two curtains
always meet in the center of the opening when the drive element is drive (rotated to the close
position. This issue is further complicated by being able to cut down the length of the tube to
fit smaller windows. If a quad-helix drive element (two clockwise and two counterclockwise
helixes) is cut down to a length that is not a multiple of $\frac{1}{2}$ the pitch of the helixes, the drive
attachment elements of the right curtain and the left curtain (for a dual curtain assembly) may
not meet in the middle of the drive element. See FIG 26. The adjustable drive attachment
element can allow the teeth to be repositioned inside the drive attachment element such that
the drive attachment element can start from a different axial position along the drive element
and end at the desired axial position in the center, or other desired axial position. This
adjustment of the position of the tooth with respect to the drive attachment element can
correct the offset caused by the odd length of the drive element, e.g., from cutting an end off,
and allows the right curtain drive attachment element and the left attachment element to meet in the middle.

The gear teeth between the "Clicker" and "Gear Ring" parts of the adjustable drive attachment element, in a specific embodiment, do not allow the "Clicker" to rotate when it is on the tube. In this case, removing the adjustable drive attachment element from the drive element allows the user to adjust the "Clicker" manually by disengaging it from the Gear Ring. The outward force of the drive element on the Clicker's gear teeth essentially locks it into the Gear Ring. Specific embodiments allow the tooth to be repositioned about one inch in either direction. For a drive element where ½ the pitch length is two inches, rotating the tube 180 degrees before installing the adjustable drive attachment element changes the starting position by ½ pitch length, which will correct the adjustable drive attachment element's starting position to an acceptable degree.

Although the structure 62 described in the embodiments above is a tooth, other embodiments for the structure 62 may be used as well.

Simple Attachment Elements

The curtain assembly 20 may further comprise a plurality of idle attachment elements 67 connected to the drive element 22 for sliding movement along the drive element 22. The remaining attachment points 68 of the curtain 34 that are not connected to the drive attachment element 36 can then be suspended from the drive element 22 using one or more idler attachment elements 67.

Referring to Figure 1, the curtain has one fixed end 64 and an adjacent opposing end 66 that is connected to the drive attachment element 36. The remaining ends (or attachment points) of the curtain 68 are positioned between the fixed end 64 and the adjacent opposing end 66 that is connected to the drive attachment element 36. These remaining attachment points 68 may be suspended from the drive element 22 using a plurality of idler attachment elements 67. The idler attachment elements 67 are interconnected to the rotatable drive element 22 as shown in FIGS. 1-4. Such interconnection of idler attachment elements 67 can be such that the idler attachment element surrounds a portion of, or all of, the circumference of the cross-section of the drive element and hangs freely on the drive element. In other embodiments, the idler attachment elements can be also interconnected with a structure external to the drive element.
The idler attachment elements 67 may be shaped similar to the drive attachment element 36. In some embodiments, the idler attachment elements 67 may have a smooth bore to allow free movement along the drive element 22 as the curtain moves. In other embodiments, the idler attachment elements 67 may have a tooth to assist in the movement of the curtain across the drive element. In embodiments having a tooth, the drive element can have a region that frees the tooth when the simple attachment element reaches a certain axial region of the drive element, such as an end of the drive element, going one axial direction, and re-engages the tooth as the idler attachment element is pulled in the other axial direction out of the same axial direction.

As shown in FIGS. 1-4, the idler attachment elements 67 may be rings that slide over the drive element 22. The idler attachment elements 67 may be provided with a slot or a hole (not shown) into which a traditional curtain hook (or loop) 37 is used to attach the remaining attachment points 68 of the curtain 44 to the idler attachment element 67 as shown in FIGS. 4-6. Curtain pins and curtain rings that are well known in the art to hang curtains may be used.

Pull Rods and Programming

In some embodiments, the drive attachment element 36 has a single tooth 62 and is a loose fit on the drive element 22. In these cases, the curtain assembly 20 can include a draw rod 70 connected to the drive attachment element 36 wherein the drive tooth 62 is disengaged from the guide structure 24 of the drive element 22 by applying force on the draw rod 70. The draw rod 70 may be an elongated rod or any other mechanism that is configured to allow the user to manually disengage the drive attachment element 36 from the guide structure 24. The draw rod can then be used to axially move the drive attachment element along the drive element.

The motor 82 for the curtain assembly 20 may be programmed from the factory with a preset number (integer or fractional) of drive element 22 revolutions to move the curtain axially across the drive element 22. There are a variety of reasons, however, why this preset number of revolutions may change. For example, the drive element 22 may be shortened (e.g., cut) to accommodate a narrower window 34 or the curtain has been manually moved with the draw rod 70 and not moved by the pull cord 72.

Therefore, in an embodiment, the initial setup of the motor 82 is able to count the number of revolutions the drive element 22 makes to fully open and fully close the curtain
This setup may be accomplished by a setup routine in which a program button is pressed once on a remote control 96 to start the motor 82 moving the curtain 44 and then pressing the button a second time, either to stop the movement or after the movement has stopped, which stores the number of revolutions the curtain 44 has moved.

In a specific embodiment, the number of revolutions can be confirmed by pressing the program button a third time, which reverses the motor 82 and moves the curtain 44 in the opposite direction. Pressing the program button a fourth time, either to stop the curtain 44 or after the movement has stopped, can cause the number of counts to be compared, and set a new count in the memory to complete the setup routine. If the program button on the remote control 96 is not pressed the second time, the motor 82 can run until the preset count is reached, then shut off. Alternatively, the assembly can implement some sort of maximum axial distance detector or force detector, or clutch, such that the motor stops, or stops rotating the drive element, respectively, when a threshold force is encountered trying to move the drive attachment element.

If it is desired to automatically move the curtain after the curtain was manually moved, the user can press the program button twice on the remote control 96, which will cycle the curtain twice. This resynchronizes the curtain movement count by first moving the curtain to one distal end of the drive element followed by moving the curtain 44 to the opposite distal end of the drive section, i.e., two cycles.

When the curtain 44 is moved towards its fully deployed position, as shown in FIG. 1, the drive attachment element 36 is driven by the rotation of the helical groove 24 on the drive element 22 acting on the feature in the drive attachment element until the drive element 22 rotates a set number of revolutions and stops in the fully deployed position.

Center Closing Embodiments

Referring to FIG. 4, a specific embodiment of the curtain assembly 20 is shown in which the curtain 44 used is a center closing curtain 46. As described above, a center closing curtain 46 is composed of two fabric panels, a right panel 50 and a left panel 48, which meet in the center of the window 42 to close and cover the window 34.

The center closing curtain 46 is in the deployed position and the window 34 is covered in FIG. 4. The drive element 22 has a clockwise helical groove 38 and a counter clockwise helical groove 40 formed on the outer surface 26 of the drive element 22. The clockwise helical groove 38 and counter clockwise helical groove 40 have the same angle and
oppose each other to create the correct movement of the center closing curtain 46 when the
drive element 22 rotates.

To accommodate a center closing curtain 46, the curtain assembly 20 has a left drive
attachment element 74 and a right drive attachment element 76 as shown in FIG. 4. The left
drive attachment element 74 is connected to the adjacent opposing end 66 of the left panel 48
and the right drive attachment element 76 is connected to adjacent opposing end 66 of the
right panel 50. In other words, the left panel 48 has a fixed end 64 and an adjacent opposing
end 66 that is connected to the left drive attachment element 74. The right panel 50 has a
fixed end 64 and an adjacent opposing end 66 that is connected to the right drive attachment
element 76. There may also be a left draw rod 78 and a right draw rod 80 attached to the left
drive attachment element 74 and the right drive attachment element 76, respectively.

The tooth 62 of the right drive attachment element 76 can follow the counter-
clockwise helical groove 40 and the tooth 62 of the left drive attachment element 74 can
follow the clockwise helical groove 38, such that when the drive element is rotated in a first
rotational direction the left panel 48 and right panel 50 both close and when the drive element
is rotated in the opposite direction the left panel 48 and right panel 50 both open. In a
specific embodiment, the drive element has only one or more clockwise helical grooves 24 on
the left end of the drive element, on which the closed left panel 48 hangs, and the drive
element has only one or more counter-clockwise helical grooves on the right end of the drive
element, on which the closed right panel 50 hangs.

Dual Curtain

Referring to FIGS. 27-30, a dual curtain assembly 1 is provided. The dual curtain
assembly 1 comprises a rotatable drive element 22 wherein at least one helical structure 24 is
formed on the outer surface 26 of the drive element 22; curtain drive elements 36A and 36B
having a corresponding structure that communicates with the helical structure 24 to move the
curtain supports axially along the drive element 22 when the drive element 22 is rotated and;
a rotation assembly 33 for rotating the drive element 22.

In some embodiments of the invention, the helical structure 24 is a helical groove and
the corresponding structure is a tooth. While the helical structure 24 is shown in FIGS. 27-30
as a helical groove, the helical structure is not limited to a groove. Similarly, the
corresponding structure discussed below in some embodiments is a tooth but is not limited to
being a tooth. In some embodiments, the curtain support includes an outer curtain outer
curtain drive attachment element 36A and an inner curtain drive attachment element 36B as shown in FIGS. 27-30 and explained further below.

The curtain assembly 1 may further comprise an outer curtain 44A and an inner curtain 44B; the outer curtain 44A is suspended from the rotatable drive element 22 while the inner curtain 44B is suspended from hooks 17 in carrier tracks 12 and 81 that move along the support guide 11. The rotatable drive element 22 comprises at least one drive element 22 having opposing distal end portions 35, 36, where the distal end having the motor can be referred to as the motor end 58 and the other distal end can be referred to as the bearing end 59, wherein at least one helical groove 24 is formed in either a clockwise direction or a counterclockwise direction on the outer surface 26 of the drive element 22 extending from one distal end portion 35, 36 of the drive element 22 to the opposing distal end portion 35, 36 of the drive element 22.

When the drive element 22 is rotated, either the outer curtain 44A or the inner curtain 44B will move along the drive element 22, while the other curtain is held in place in a non-driving or stall area. Once the moving drive attachment element 36A or 36B has reached a stall area at the end of the drive element 22, the non-moving drive attachment element will be tugged to engage the helical groove 24. This movement of the outer curtain 44A and the inner curtain 44B, along the helical groove 24 of the drive element 22 is explained in greater detail below. Whether the outer curtain 44A moves or the inner curtain 44B moves is determined by the sequence of the movement of the curtains. A system for selecting either the outer curtain 44A or the inner curtain 44B is explained below.

As shown in FIG. 27, the outer curtain 44A and inner curtain 44B may be composed of a single continuous panel of fabric that moves back and forth across the drive element 22 to the deployed position (covering the window 34) and to the stored position (not covering the window 34). Although, there is no limitation on the type of fabric used for the curtains 44A and 44B, in one embodiment, the outer curtain 44A is a blackout curtain and the inner curtain 44B is a sheer curtain. Using a blackout curtain with a sheer curtain to cover the same window 34 allows the user to use the sheer curtain when some light is desired and then also to use the blackout curtain when no light is desired. For example, the blackout curtain may be stored and the sheer curtain may be deployed, if some light is desired and privacy is needed. The blackout curtain may be deployed and the sheer curtain may be deployed when no light is desired. The blackout curtain may be stored and the sheer curtain may also be stored, when light is desired and privacy is not needed. The dual curtain assembly 1
disclosed herein allows for these combinations of positions for the outer curtain 44A (blackout curtain) and the inner curtain 44B (sheer curtain) as shown in FIGS. 27-30.

FIG. 27 illustrates a curtain assembly 1 when the outer curtain 44A is a blackout curtain in the deployed position and the inner curtain 44B is a sheer curtain in the deployed position. Therefore, in FIG. 27, the window 34 is covered by the outer curtain 44A or the blackout curtain and the inner curtain 44B. FIG. 28 illustrates a curtain assembly 1 when the outer curtain 44A is a blackout curtain in the stored position and the inner curtain 44B is a sheer curtain in the deployed position. The window 34 is covered by the sheer curtain and the blackout curtain is stored in this instance. FIG. 29 illustrates a curtain assembly 1 when the outer curtain 44A is a blackout curtain in the stored position and the inner curtain 44B is a sheer curtain in the stored position. The window 34 is left uncovered in this instance.

FIG. 30 illustrates the preferred embodiment curtain assembly 1 when the outer curtain 44A is a blackout curtain in the deployed position and the inner curtain 44B is a sheer curtain in the deployed position. Therefore, in FIG. 27, the window 34 is covered by the outer curtain 44A or the blackout curtain and the inner curtain 44B. Further, the outer curtain has the stationary end attached to the end bracket 54 and the movable end wrapped around the other end bracket 54 on the distal end. There is also a cut away area to show the position of an external power supply 43.

Drive Element and Drive Section

The rotatable drive element 22 will now be explained in detail below. The curtain assembly 1 includes a rotatable drive element 22. FIGS. 31 and 32 show the rotatable drive element 22 and its components in greater detail. Both the outer curtain 44A and the inner curtain 44B are connected to the rotatable drive element 22 by the outer curtain drive attachment element 36A or the inner curtain drive attachment element 5 or various attachment and suspension elements as explained below. The rotation assembly 33 which rotates the drive element 22 moves these attachment drive elements which are connected to the curtains 44A and 44B separately across the drive element 22.

The rotatable drive element 22 is designed to be installed above a window 34 similar to a traditional curtain rod. For example, as shown in FIG. 27, drive element 22 is mounted on axles 52 that are located and secured in the end brackets 54. The end brackets 54 are adapted for connection with a window frame, sash or wall. The end brackets 54 may also
include a rubber mounting disk 13 that is compressed when the drive element 22 is installed to hold the drive element 22 firmly in place and minimize noise.

The drive element 22 is connected to a rotation assembly 33 for rotating the drive element 22 wherein the rotation of the drive element 22 moves the outer curtain drive attachment element 36A and the inner curtain drive attachment element 36B separately across the helical groove 24 of the drive element 22. The rotation assembly 33 may be a draw cord 72 connected to the drive element 22 or a motor 82. The drive element 22 may be rotated manually. For example, a draw cord 72 as shown in FIGS 27-29 may be connected to the drive element 22 such that the drive element 22 can be manipulated manually to rotate when it is desired to deploy or store the curtains 44A or 44B. The use of pull cords 72 is well known in the art.

The drive element 22 may also be connected to a motor 82, which can be used to rotate the drive element 22. The motor 82 may be mounted either inside or outside the drive element 22. In one embodiment, the motor 82 is mounted inside the drive element 22 and generally concealed from plain view. Components including axles 52 and bearings 94 may also be located inside the rotatable drive element 22. A slip ring 28 may be used to transfer current from the power supply 43 external to the drive element 22 to the motor 82 in the drive element 22 as shown in FIG. 32. Alternatively, batteries 84 in a battery tube 86 may be used as shown in FIG. 31 to power the motor 82. The batteries 84 in the battery tube 86 may be in a spring loaded sleeve to assist with loading and unloading batteries 84 from the battery tube 86. In some embodiments, the motor drive adapter 27 as shown in FIG. 59 may also be used to securely attach or connect the motor 82 to the drive element 22. In other embodiments, the motor housing 53 fits tightly against the drive element 22 and turns the drive element 22 when the motor output shaft 87 is held in end bracket 54 to prevent it from turning.

In a motorized operation, the user may push a button 98 on a remote control 96 to turn on the motor 16 to rotate the drive element 22 such that the sequence selected curtain 44A or 44B moves across the drive element 22 between a stored position and a deployed position depending on the user's preference. The remote control 96 and button 98 are shown in FIGS. 27-29. In other embodiments, the remote control may respond to a voice command and send a signal to the motor controls, which then causes the motor 82 to rotate the drive element 22.

The curtain assembly 1 may also include a remote control 96 having a control board which generates a signal when the user makes a selection on the remote control 96. The control board has a transmitter which can wireless communicate with a receiver which is
remotely located from the transmitter. For example, the receiver may be located in the drive element 22. The receiver receives the transmitted signal from the transmitter and transmits it to the motor 82, which will cause the motor 82 to turn on, rotate the drive element 22, and moves one of the curtains 44A or 44B.

As the drive element 22 rotates, either manually or by a motor 82, the outer curtain drive attachment element 36A or the inner curtain drive attachment element 36B is engaged on the drive element 22 and moves across the drive element 22 to either a deployed or stored position while the other curtain 44A or 44B remains in place. When the moving curtain 44A or 44B reaches the end of the drive element 22, the stationary curtain 44A or 44B will be pulled into engagement with the helical groove 24 and move across the drive element 22 to a new position.

The rotatable drive element 22 is preferably cylindrical in shape as shown in FIGS. 31, 32, 34, and 59, which shows the drive element 22 having an inner tube, referred to as an inner drive element 9, and an outer tube or sleeve 63. However, the shape of inner drive element 9 and an outer tube or sleeve 63 of the drive element 22 are not limited and can be non-circular. In an alternative embodiment, as shown in FIG. 60, the rotatable drive element 22 may be tri-lobed. In this case the drive element is a spiraled tube having creases that a ball bearing can ride in.

The drive element 22 may vary in size. For example, the drive element 22 may be the width of the window 34 or it may be wider than the window 34. There is no limitation on the diameter of the drive element 22 other than space needed inside a room. Preferably, the drive element 22 is configured to mount a motor 82 inside the drive element 22 rather than mounting the motor 82 outside the drive element 22. Using the inside of the drive element 22 to conceal the motor 82 may give a more aesthetically pleasing design for a curtain assembly 1 or 20. Any number of materials may be used to fabricate the drive element 22 provided the drive element 22 can support the weight of the outer and inner curtains 44A, 44B.

The drive element 22 comprises a guide structure 24, such as a helical groove, over at least one or more portions of the length of the drive element 22. The drive element 22 has opposing distal end portions 35, 59 and may be any length along the longitudinal axis 60 of the drive element 22. The longitudinal axis 60 of the drive element 22 is shown in FIGS. 27-30. The length of the guide structure along the drive element 22 is a factor in determining how far the curtain 44A or 44B will travel across the drive element 22, i.e., the entire length of the drive element 22 as opposed to some shorter section of the drive element 22.
In an embodiment, the drive element 22 has at least one helical groove 24 that is formed in either a clockwise direction or a counterclockwise direction on the outer surface 26 of the drive element 22 extending from one distal end portion 35, 59 of the drive element 22 to the opposing distal end portion 35, 59 of the drive element 22. FIG. 49 illustrates a left hand drive element 22 in which the helical groove 24 is in a clockwise direction and also illustrates a right hand drive element 22 in which the helical groove 24 is in a counterclockwise direction.

In some embodiments, the drive element 22 may have two helical grooves 24, one formed in the clockwise direction and one formed in the counterclockwise direction as shown in FIG. 59. A drive element 22 having helical grooves 24 in both directions is particularly useful for center closing curtains 46 as explained below.

In the preferred embodiment, the drive element 22 may have two helical grooves 24 in the same direction, where the inner drive attachment element 36B has two teeth 5a and 5b spaced 180 degrees apart and the outer drive attachment element 36A has two teeth 4a and 4b spaced 180 degrees apart, such that tooth 4a, and tooth 5a, engages one of the helical grooves and tooth 4b, and tooth 5b, engages the other helical groove at the same time, respectively, so as to add stability with respect to driving drive attachment element 36A, and 36B, respectively.

In other embodiments, the drive element preferably has four helical grooves 24, two clockwise helical grooves 24 and two counterclockwise helical grooves 24 as shown in FIG. 59. A cross-sectional view of the rotatable drive element having four helical grooves 24, two clockwise helical grooves and two counterclockwise helical grooves is shown in FIG. 59. Helical grooves are preferably spaced approximately 180 degrees apart. The clockwise helical grooves 24 and the counterclockwise helical grooves 24 preferably opposed each other and are spaced 180 degrees apart. The profile of the helical grooves 24 is self-centering to allow the first outer drive tooth 4a and the first inner drive tooth 5a to traverse the intersection of the clockwise helical groove and the counter clockwise helical groove without binding.

The helical groove 24 forms a path through the drive element 22 as shown in FIGS. 27-30. As the drive element 22 rotates, one of the curtains 44A or 44B is pulled along the helical groove 24 across the drive element 22 into a deployed or stored position. Both the clockwise and the counterclockwise helical grooves 24 will cause the curtain 44A or 44B to
move axially across the drive element 22 when the drive element 22 rotates and the curtain drive elements 36A or 36B are engaged with the helical groove 24.

The helical grooves 24 may be formed by forming grooves into the outer surface 26 of the drive element 22 such that the grooves are recessed from the outer surface 26 of the drive element 22. Alternatively, the helical grooves 24 may be formed as protrusions that project or bulge from the outer surface 26 of the drive element 22. The protrusions may be formed any means, for example, by winding material around the outer surface 26 of the drive element 22.

The angle of the helical groove 24 may vary and therefore, may differ in the amount of time that it takes to travel across the drive element 22. For example, a helical groove 24 with a larger angle may create a shorter path for the curtain 44A, 44B to travel and result in a faster moving curtain 44A or 44B for a given rotational speed of the drive element. In some embodiments, the angle of the helical grooves 24 may vary along the drive element 22 such that the curtain 44A, 44B may move at different speeds along the drive element 22, for a given rotational speed of the drive element, if desired. The angle of the helical groove 24 preferably varies from 30 degrees to 60 degrees and is most preferably 45 degrees.

In an alternative embodiment, the drive element 22 may be formed from a drive sleeve or outer tube 63 that is sized to fit around a portion of an inner drive element 9, which can be, for example, an inner tube 61. In this case, the drive sleeve has at least one helical groove 24 in a clockwise or counter clockwise direction formed on the outer surface of the sleeve. The drive element 22 must be able to translate the torque from the rotation assembly to axially movement of the curtain support or attachment elements 36A, 36B across the drive element 22, and the drive sleeve may be made from a high lubricity material. Therefore, the drive sleeve can be secured to the inner drive element 9 such that the sleeve does not slide up or down the drive element 22 or rotate around the inner drive element 9. It may also be desired to remove the sleeve from the inner drive element 9 and replace it with another sleeve. Using a sleeve to form the drive element 22 has the advantage that the helical groove 24 or the length of the drive element 22 may be easily changed by removing the sleeve and replacing it without fabricating a new drive element 22.

Attachment Elements and Teeth

In some embodiments, the curtain assembly 1 may include at least one outer curtain drive attachment element 36A connected to the drive element 22 and has a drive teeth 4a and
4b that communicates with the helical groove 24 to move the outer curtain drive attachment element 36A axially along the drive element 22 when the drive element 22 is rotated. The outer curtain drive attachment element 36A is connected one end of the outer curtain 44A. The curtain assembly 1 may include at least one inner drive attachment element 36B connected to the drive element 22 and has a drive teeth 5a and 5b that communicates with the helical groove 24 to move the inner drive attachment element 36B axially along the drive element 22 when the drive element 22 is rotated. The inner drive attachment element 36B is connected one end of the inner curtain 44B.

FIGS. 45-47 show the front and cross-sectional views of the outer curtain drive attachment element 36A as well as the drive teeth 5a and 5b. Both the first outer drive tooth 5a and the second outer drive tooth 5b are configured to communicate with the helical groove 24 of the drive element 22. The first outer drive tooth 5a and the second outer drive tooth 5b are positioned inside the outer drive attachment element 36A which shows the angle α of one drive tooth and both the angles are 45 degrees.

FIGS. 39-41 show the front and cross-sectional views of an embodiment of an inner drive attachment element as well as the drive teeth 4a and 4b. Both the inner drive tooth 4a and the inner drive tooth 4b are configured to communicate with the helical groove 24 of the drive element 22. The inner drive tooth 4a and the inner drive tooth 4b are positioned inside the drive attachment element which shows the angle α of one drive tooth and both the angles are 45 degrees. In this embodiment, the inner carrier attachment post 31 is located at a portion of the inner drive attachment element designed to interconnect with a carrier in the inner curtain carrier track 81.

FIGS. 36-38 show the front and cross-sectional views of an alternative inner drive attachment element 36B as well as the drive teeth 4a and 4b. Both the inner drive tooth 4a and the inner drive tooth 4b are configured to communicate with the helical groove 24 of the drive element 22. The inner drive tooth 4a and the inner drive tooth 4b are positioned inside the drive attachment element which shows the angle α of one drive tooth and both the angles are 45 degrees. In this embodiment, the inner carrier attachment post 31 can be the same as the outer carrier attachment post 6 of Figures 45-47 designed to interconnect with a carrier in the outer curtain carrier track 12, and the attachment points of the inner curtain can attach via hooks to the receiver for hooks 99.

As shown in various figures, the outer curtain outer curtain drive attachment element 36A and the inner curtain drive element 36B are ring-shaped and slide over the drive element
22. Although a different construction may be used for the outer curtain drive attachment element 36A and the inner curtain drive element 36B, they are be able to connect to the appropriate ends of the outer curtain 44A and the inner curtain 44B and engage the helical groove 24 and move across the drive element 22.

The outer curtain outer curtain drive attachment element 36A is preferably provided with a slot or a hole 99 into which a traditional curtain hooks or pins can be used to connect the ends and upper edge of the outer curtain 44A to the appropriate attachment element. FIG. 34 illustrates an example of the hole 99 and a pin hook 14 on an outer curtain idler attachment element 67A. In another embodiment, as shown in FIG. 60, a traditional curtain ring is used. The inner curtain 44B is suspended by S-hooks 17 in inner curtain carrier track 81 in support guide 11. Curtain pins, hooks and rings are well known in the art to hang curtains 44A, 44B.

The drive tooth 5a on the outer drive attachment element 36A and the drive tooth 4a on the inner drive attachment element 36B may have the same construction. The outer drive tooth 5a and the inner drive tooth 4a are both designed to engage with the helical groove 24 of the drive element 22 to drive the curtain 44A or 44B across the drive element 22. In one embodiment, the drive tooth 5a is formed on an angle inside the body of the outer curtain drive attachment element 36A. The angle is specifically designed to engage the helical groove 24 on the drive element 22. A design consideration is to maximize the contact between the rotating drive element 22 and the outer drive attachment element 36A and/or inner drive attachment element 36B to carry the weight of the curtain 44A or 44B. The outer curtain outer curtain drive attachment element 36A and the drive teeth 5a and the inner curtain drive attachment element 36B teeth and the inner curtain teeth 4a, in some embodiments of the present invention, are adjustable. The adjustability of these components allow the user of the curtain assembly to set the correct timing on the location of the outer curtain drive attachment element(s) 36A and inner curtain drive attachment element(s) 36B in relationship to the helical grooves 24.

Although the curtain support described in the embodiments above is an outer curtain outer curtain drive attachment element 36A and an inner curtain drive attachment element 36B, other embodiments for the curtain support may be used as well.
Outer Curtain Idler Attachments

The curtain assembly 1 may further comprise a plurality of outer curtain idler attachment 67A connected to the rotatable drive element 22 for sliding movement along the drive element 22 wherein the adjacent ends of the outer curtain 44A that are not connected to the outer curtain drive attachment element 36A are suspended from the drive element 22 using one or more outer idler attachment elements 67A.

The outer curtain 44A has the movable end connected to the outer drive attachment element 36A. The non-movable end of the outer curtain 44A can be attached to the end bracket 54. Outer idler attachment elements 67A may be used to suspend the remaining attachment points of outer curtain 44A to the drive element 22. The outer idler attachment elements 67A are connected to the rotatable drive element 22 as shown in FIGS. 31-32 and 34-35. An enlarged view of the outer idler attachment 67A is shown in FIGS. 42-44.

The outer idler attachment 67A may be shaped similar to the outer drive attachment element 36A and inner drive attachment element 36B. The outer idler attachment 67A can have a smooth bore to allow free movement along the drive element 22 of the tube as the curtain 44A is moved or may have a tooth on each outer idler attachment 67A to assist in the movement of the curtain 44A.

The outer idler attachments are also linked to the outer curtain carriers 69 by the insertion of the outer carrier attachment post 6 on the outer idler attachment elements 67A into the aperture 55 on outer curtain guide carrier 69. The outer curtain carriers are then positioned in the outer curtain carrier track 12 in the support guide 11. This prevents the outer curtain idler attachment 67A from rotating or binding the rotation of the element 22.

The outer curtain idler attachment 67A are preferably provided with a slot or a hole 99 into which a traditional curtain hook or pin can be used to attach the ends of the outer curtain 44A to the outer curtain idler attachment. FIG. 42 illustrates an example of this hole 99 and a pin hook 14 on an outer curtain idler attachment 67A.

The inner curtain 44B can have the stationary end connected to the end bracket 54 and other end attached to the inner drive attachment element 36B. The inner curtain carrier track 81 and hooks 17 may be used to suspend the remaining attachment points of the inner curtain 44B to the inner curtain carrier track 81 of the support guide 11 along the axis of the drive element 22.

The outer curtain 44A is connected to the outer drive attachment element 36A and the inner curtain 44B is attached to the inner drive attachment element 36B. This arrangement
ensures that the outer curtain 44A and inner curtains 44B drive attachment elements 36A and 36B are linked together on the same drive element 22 and they are able to move in sequence across the drive element 22.

Outer Driver Stall Area and Inner Driver Stall Area

The curtain assembly 1 preferably includes at least one outer driver stall area 100 positioned to one end of the drive element 22 to engage and disengage the outer drive attachment element 36A from the helical groove 24 of the drive element 22.

The curtain assembly 1 also preferably includes at least one inner driver stall area 15 positioned on the distal end of the drive element 22 that is configured to hold the inner curtain drive element 36B in place while the outer drive attachment element 36A moves through the drive element 22.

FIGS. 33-34 show an outer driver stall area 100 at one distal portion 35, 59 of the drive element 22. FIG. 51 shows the inner driver stall area 15 at the opposing distal end 35, 59 of the drive element 22. FIG. 49 shows a rotatable drive element 22 having an outer driver stall area 100 at each distal end portion of the drive element 22 and an inner driver stall area 15 positioned in between the two stall areas 100. The rotatable drive element 22 shown in FIG. 49 will accommodate the outer curtains 44A and inner curtains 44B, as center closing curtains.

Enlarged views showing details of the outer driver stall area 100 are shown in FIG. 34. The outer driver stall area 100 is a section of the drive element 22 along the drive element 22 without a helical groove 24 formed on the outer surface 26 of the drive element 22. The outer driver stall area 100 interrupts the movement of the outer curtain 44A or the inner curtain 44B along the helical groove 24 therefore allowing the curtain assembly 1 to change which attachment element (either the outer curtain drive attachment element 36A or the inner curtain drive element 36B) is engaged with the helical groove 24.

Referring to Figures 52-54, the outer driver stall area 100 also serves to collect or provide a space for the outer curtain idler attachment elements 67A as well as the outer curtain drive attachment element 36A. For example, when the outer curtain drive attachment element 36A is engaged and moves through the drive element 22, it will reach the outer driver stall area 100 at the end of the drive section. The outer driver stall area 100 stops the movement of the outer curtain drive attachment element 36A in the helical groove 24 and temporarily stores the outer curtain drive attachment element 36A. The outer curtain idler
attachment elements 67A that are holding the remaining adjacent end of the curtain 44A are pushed by the outer curtain drive attachment element 36A and ultimately stack up in the outer driver stall area 100 until the outer curtain drive attachment element 36A becomes disengaged with the helical groove 24 and will remain stalled until the drive element 22 rotates in the opposite direction. As this disengagement occurs, the outer curtain drive attachment element 36A pushes against the outer curtain idler attachment 67A in the outer driver stall area 100 which moves the inter-curtain engager 49 toward the end bracket 54. The inner curtain 44B, being the correct length, pulls the inner curtain drive element out of the inner driver stall area 15 and into engagement with the helical grooves 24.

In some embodiments, the inner driver stall area 15 is positioned at the distal end 59 of the drive element 22 opposite the outer driver stall area 100 and functions to hold the inner curtain drive element 36B stalled in place. In other embodiments, at least one inner driver stall area 15 is positioned between two outer driver stall areas 100, as shown in FIG. 49. The position of the inner driver stall area 15 on the drive element 22 defines the end of the portion of the drive element 22 where the inner curtain drive element 36B travels on the drive element 22.

As described above, FIG. 27 shows a curtain assembly 1 when the outer curtain 44A (blackout) is in the deployed position and the inner curtain 44B is also in the deployed position. At this moment, the outer curtain 44A is fully extended and the curtain drive attachment element 36A is in the helical groove 24 at one distal end of the drive element 22 and the inner curtain drive element 36B is in the inner driver stall area 15 at the same end of the drive element 22. To change the positions of the curtains such that the outer curtain 44A is in the stored position and the inner curtain 44B stays in the deployed position as shown in FIG. 28, the drive element 22 starts to rotate in the opposite direction. The rotation of the drive element 22 will move the outer curtain drive attachment element 36A, attached to outer curtain 44A, collapsing curtain 44A into the stored position until outer curtain drive attachment element 36A moves into the outer driver stall area 100 where it will push against the outer idler attachment elements 67A in the outer driver stall area and force the inter-curtain engager 49 toward the end bracket 54 creating a tug pressure on the inner curtain 44B and the inner curtain drive element 36B because the inner curtain 44B is the correct length and extended. This tug pressure pulls the inner curtain drive element 36B out of the inner driver stall area 15 and into engagement with the helical groove 24 positioning the curtains as shown in FIG. 28. When the inner curtain 44B is fully extended, the inner curtain drive
element 36B will move into the inner driver stall area 15. Because the inner curtain is now extended, the outer curtain drive attachment element 36A will be pulled into the helical groove 24 prepared to deploy the outer curtain 44A. Because the inner driver stall area 15 does not have a helical groove 24, the inner curtain attachment 36B element is prevented from moving or stalled along the drive element 22.

As the outer drive attachment element 36A moves through the drive element 22, the outer curtain 44A will move from the stored position to the fully deployed position and the outer drive attachment element 36A moves up to and against the inner curtain drive element 36B in the inner driver stall area 15 and stops the drive element 22 from rotating. The curtain assembly 1 will then be as shown in FIG. 27, with the outer curtain 44A in the deployed position and the inner curtain 44B in the deployed position.

To move the inner curtain 44B to the stored position as shown in FIG. 29, the drive element 22 will rotate and the outer drive attachment element 36A moving into the outer driver stall area 100 will pull the inner curtain drive element 36B from the inner driver stall area 15 thereby engaging the inner curtain drive element 36B with the helical groove 24. The inner curtain drive element 36B will move the curtain 3 through the drive element 22 from the deployed position to the stored position at the other distal end of the drive element 22 until the inner curtain drive element 36B pushes against the outer drive attachment element 36A and stops the drive element 22 from rotating. At this point, the inner drive attachment element 36B is engaged with the helical groove 24.

Guide Mechanism

The curtain assembly 1 preferably includes a support guide 11 wherein the guide means facilitates the movement of the outer and inner curtains 44A, 44B along the drive element 22 without misalignment. The support guide 11 may also assist with the spacing of the curtain panels when the outer curtain 44A or the inner curtain 44B is fully extended in the deployed position.

In one embodiment, the support guide 11 is an elongated pair of channels positioned parallel to the rotatable drive element 22. The support guide 11 is shown in several of the figures, including an end view in FIG. 48. The inner curtain carrier track 81 and the outer curtain carrier track 12 are the same part but are numbered differently and discussed differently because their functions are different. The inner curtain carriers 93 have apertures 55 where an inner carrier attachment post 31 on the inner curtain drive element 36B is
inserted at one end of the inner curtain and an inner carrier attachment post 31 on the inter-
curtain engager 49 is inserted on the other end. The remaining inner curtain carriers 93 have
S-hooks 17 inserted into the aperture 55 as known in the art.

The outer drive attachment element 36A and the outer curtain idler attachment 67A
preferably have a hanger pin hole 99 wherein the pin hooks 14 are connected to the
attachment elements and support the outer curtain 44A. Further, these attachment elements
36A and 67A to the outer curtain 44A are guided and held from rotation by the insertion of
the outer carrier attachment posts 6 into the apertures 55 in curtain carriers 69 riding in the
outer curtain carrier track 12 in support guide 11.

This arrangement provides the user with the option of manually operating the
movement of the curtains 44A or 44B across the drive element 22. For example, the user
may decide to manually operate the curtain assembly 1. The user could turn off the motor 82
and rotate the drive element 22 manually by using the pull cord 72.

The motor 82 for the curtain assembly 1 may be programmed from the factory with a
preset number of drive element 22 revolutions to move the curtain the width of the window
34 opening. However, there are a variety of reasons why this preset number of revolutions
may change. For example, the drive element 22 may be shortened to accommodate a
narrower window 34.

Therefore, the initial setup of the motor 82 may be able to count the number of
revolutions the drive element 22 makes to fully open and fully close the curtains 44A or 44B.
This may be accomplished by a setup routine where pressing a program button 98 on a
remote control 96 once to start the motor 82 moving the curtain 44A, 44B and then pressing
the button 98 another time to stop the movement which will store the number of revolutions
the curtain 44A, 44B has moved.

The number of revolutions can be confirmed by pressing the program button 98 a
third time, which will reverse the motor 16 and move the curtain 44A, 44B in the opposite
direction. Pressing the program button 98 a fourth time will stop the curtain 44A, 44B,
compare the counts, and set a new count in the memory to complete the set up routine. If the
program button 98 on the remote control 96 is not pressed the inner time, the motor 82 will
run until the preset count is reached, then the motor 82 will shut off. If the number of
revolutions is ever lost, the controls can reset a zero position when the outer curtain drive
attachment element 36A stops the drive element 22 from rotating when the outer curtain 44A
is fully deployed, as shown in FIG. 52 or when the outer curtain 44A and the inner curtain
44B are fully stored and the inner curtain drive element 36B stops the drive element 22 from rotating, as shown in FIG. 54.

In specific embodiments, the drive element 22 stops rotating when the inner driver attachment element 36B and the outer driver attachment element 36A are brought into contact at either end of the drive element. When the inner driver attachment element 36B and the outer driver attachment element 36A are brought into contact, the inner driver attachment element 36B and the outer driver attachment element 36A bind together and their teeth bind in the drive element's grooves. The interconnection of the inner driver attachment element 36B and the outer driver attachment element 36A to the support guide 11 in opposite orientations helps to cause this binding. Once the inner driver attachment element 36B and the outer driver attachment element 36A bind together, the drive element is bound, and the controller board senses that the driver element is no longer rotating and stops running the motor.

In specific embodiments, the stall area 100 and/or 15 prevents one of the inner driver attachment element 36B and the outer driver attachment element 36A from moving down the drive element 22. When the inner driver attachment element 36B and the outer driver attachment element 36A meet each other, the axial force (down the rotational axis of the rotating drive element) binds the stalled driver to the still-driving driver. This, coupled with the weight of the curtain hanging from the outer driver and the interconnection of the inner driver attachment element 36B and the outer driver attachment element 36A to the support guide, causes the driver whose teeth are still engaged to the tube to bind up with the rotational drive element. At that point, this driver is being torqued so as to try and rotate around the axis of rotation and prevented from such rotation by the support guide, which stalls the motor and signals the controller board to stop running the motor.

The dual curtain assembly mounted in rubber mounting disk 13 increases the sensitivity of motion such that a person can pull on the stored or deployed curtain and activate the motor to move the curtain in the opposite direction from the last movement. The motor controls will count the number of revolutions and when the predetermined count is matched it will shut the motor down. Specific embodiments can employ one or more accelerometers or other sensors that can allow a user to activate and/or control the curtain assembly. A variety of sensors can be utilized, including a sensor detecting a force or torque applied to the drive element or other component of the assembly, such as a force in a direction perpendicular to the longitudinal axis of the drive element or a torque applied to the
drive element about the longitudinal axis of the drive element. Examples of sensors that can be utilized include, but are not limited to, sound detectors, vibration sensors, strain and/or stress sensors, length detector (e.g., length of stretchable curtain), gyroscopes, load sensors and motion sensors. The accelerometer or sensor can be connected to the system in any manner. In one arrangement, the accelerometer or sensor is positioned within the drive element 22. The accelerometer or sensor can be positioned on the window covering, a draw cord, a battery sleeve, a drive attachment element, an idle attachment element, or other component of the system. In another embodiment, the accelerometer or sensor is connected to a bracket. In yet another arrangement, the accelerometer or sensor is included as part of the motor control board as a component thereof.

Specific embodiments can allow a user to pull down on the curtain, e.g., the deployed curtain or stored curtain, and communicate one or more command. The command can be based on, for example, the length of time of the application of the force, the magnitude of the force applied, the number of times the force is applied, the elapsed time between multiple applications of force, the pattern of the force applied, and/or the current state of the curtain. The command can be, for example, one or more of the following: open the curtain, close the curtain, close the curtain if curtain open, open the curtain if curtain closed, stop curtain in current location, open, or close, curtain to specific location (e.g., a preset location (state) or a location (state) taught to the system by the user), open the inner curtain only, open the outer curtain only, open both the inner and outer curtain, close the inner curtain only, close the outer curtain only, close both the inner and outer curtain, open the inner and/or outer curtain to a specific location, open or close a single curtain or inner and outer curtain to one or more states (e.g., to a preset state or a state taught to the system by the user), to remember the current location (state), open, or close, one or more curtains until the force is terminated, and/or other useful commands in a manner similar to commanding the system using, for example, a remote control.

The force or other mechanical input can be provided by the user through a switch (e.g., a button, toggle switch, or other mechanism mounted to the system or near the system), a cord or other structure interconnected with the system. As an example, a cord can be provided such that when a user pulls on the cord a torque is applied to the drive element 22 or other portion of the system, a force is applied to the drive element 22 or other portion of the system, a switch is activated or toggled, a magnetic material is moved, and/or a physical input is provided to the system. In a specific embodiment, two cords or other structures (e.g., two
rods) can be provided such that if the first cord is pulled a first command (such as open one or more curtains) is inputted and if the second cord is pulled a second command (such as close one or more curtains) is received.

Center Closing Embodiments

An alternative embodiment of the dual curtain assembly 1 is shown in FIGS. 49 and 50 in which the outer curtain 44A and the inner curtain 44B are center closing curtains. A center closing curtain is composed of two fabric panels, a right panel and a left panel, that meet in the center of the window 34 to close and cover the window 34. In FIG. 50, the outer curtain 44A is a center closing blackout curtain that is in the deployed position and the inner curtain 44B is a center closing sheer curtain that is also in the deployed position. In FIG. 49, the outer curtain 44A is a center closing blackout curtain that is in the stored position and the inner curtain 44B is a center closing sheer curtain that is in the deployed position. In this embodiment, the drive element 22 of the drive element 22 preferably has four helical grooves 24, two formed in the clockwise direction and two formed in the counterclockwise direction. For example, the opposing helical grooves 24 shown in FIG. 59 create the correct movement of the center closing curtains with one motor 82 turning the drive element 22 in one direction.

FIG. 59 shows an enlarged cross-sectional view of the rotatable drive element according to one embodiment of the curtain assembly showing the four helical grooves formed on the outer surface of the drive element. FIG. 59 also shows an enlarged perspective view of the rotatable drive element according to one embodiment of the curtain assembly showing the four helical grooves formed on the outer surface of the drive element.

To accommodate center closing curtains, the curtain assembly 1 has a left outer drive attachment element 36A, a right outer drive attachment element 36A, a left inner drive element 36B and a right inner drive attachment element 36B as shown in FIGS. 49 and 50. The left outer drive attachment element 36A is connected to one end of the left panel of the outer curtain 44A. The right outer drive attachment element 36A is connected to one end of the right panel of the outer curtain 44A. The left inner drive element 36B is connected to an adjacent end of the left panel of the inner curtain 44B and the opposite end of the inner curtain is attached to the end bracket 54. The right inner drive attachment element 36B is connected to adjacent end of the right panel of the inner curtain 44B and the opposite end of the inner curtain is attached to the end bracket 54.
FIG. 49 shows an embodiment of a rotatable drive element 22 in which the outer curtain 44A and the inner curtain 44B are both center closing curtains. There is an outer driver stall area 100 positioned at each distal end of the rotating drive element 22 and an inner driver stall area 15 positioned between the outer driver stall areas 100. For example, there is a left outer driver stall area 100 positioned along the drive element 22 to engage and disengage the left outer drive attachment element 36A from the helical groove 24 of the drive element 22 and a right outer driver stall area 100 positioned along the drive element 22 to engage and disengage the right outer drive attachment element 36A from the helical groove 24 of the drive element 22. The inner driver stall area 15 is configured to hold the left inner drive element 36B in place while the left outer drive attachment element 36A moves through the drive element 22. The same inner driver stall area 15 is also configured to hold the right inner drive attachment element 36B in place while the right outer drive attachment element 36A moves through the drive element 22. Alternative embodiments can have two separate inner driver stall area 15. FIG. 49 illustrates that the left and right inner drive attachment elements 36B will meet in the center 42 of the window 34 when the outer curtain 44A is deployed and the inner curtain 44B is stored to minimize light leakage. Therefore, the single inner driver stall area 15 in some embodiments is wide enough to fit both the left inner curtain drive element 36B and the right inner curtain drive attachment element 36B.

FIGS. 63A-63L show flowcharts implemented by the control system for specific embodiments of the invention.

Embodiment - Method and Apparatus for Linked Horizontal Drapery Panels Having Varying Characteristics to be Moved Independently by a Common Drive System

A system having two horizontal moving curtains or draperies made from dissimilar materials can display each of the two curtains individually, using a common drive system. The drive system can be operated manually by, for example, a pull cord or a draw rod, and can be motorized. In the embodiment, shown in Figures 64-77, the horizontal movement of the curtain or drapery is accomplished by one or more grooves, such as one or more helical grooves, formed on the outer surface of a rotating element, such as a roll shade tube, to move the curtain or drapery horizontally when the tube rotates. The drive element can also utilize a sleeve over a tube, such that the sleeve has the one or more grooves and rotating the tube rotates the sleeve. The sleeve and tube can be the same material or different materials. A sleeve made of non-metallic material over a metallic tube can provide the strength of a
metallic tube with a low friction non-metallic surface of the sleeve material to interconnect with the attachment elements.

The curtains or draperies (such as sheer and blackout curtains or draperies) are suspended by loosely fitting attachment elements that freely traverse longitudinally along the tube with a protrusion or protrusions on the inside of the drive element fitted into the helical grooves in the rotating element. The remaining attachment elements are loose fitting where the curtain materials can be moved independently (freely) along the tube to cover or uncover the opening as needed. This drive system can be used on shade systems referred to as a single set of shades, where a single set of shades traverse the same tube and can be stored to the right or the left of the opening. This drive system can also be used on a center opening set of shade systems, where the left hand and right hand sets of shades open from the middle of the opening and the shades are stored to either side of the opening when the shades are open.

In describing this embodiment, the terms draperies, curtains, and shades are used interchangeably. The drive mechanism for the two draperies can be linked together such that a common drive system can move each curtain individually and/or together. The shades can be moved by rotating the drive element, which in the embodiment shown in Figures 62-77, is a tube. The tube can be motorized so that a motor drives the tube. The system can be designed such that the tube can be manually rotating the drive element. Specific embodiments can allow both manual and motorized driving of the tube.

A magnetic attachment mechanism can be incorporated such that one shade can be manually moved by disconnecting a magnet from the drive element. The system can be designed such that the magnet of the magnetic attachment mechanism is automatically engaged when the magnets are moved slowly enough when the magnets are proximate to each other, and when the magnets are moved rapidly with respect to each other when the magnets are proximate to each other the magnets will not engage. The proximity of magnet 124 and magnet 135, and their orientation with respect to each other are the primary factors as to whether or not the magnets engage each other so as to couple the outer driver and inner driver. The speed of passing is also a factor. Magnet 124 is allowed to pivot about an axis while magnet 135 is held relatively stationary at some pre-determined angle. When the opposite poles of the magnets are proximate, they engage. As the pivoting magnet is moved past the relatively stationary magnet, the opposite poles are force passed each other (by virtue of the relatively stationary magnet being pushed into the "cup" mechanism, and the pivoting magnet continuing its linear travel along the rotating element's rotational axis. As the edges
of the magnets pass each other, they suddenly repel each other. The pivoting magnet then turns its other pole toward the stationary magnet. When the magnets are in this configuration and the movement is reverse, they maintain this repelled state until the pivoting magnet reaches a position where the edges of the magnets again align. In this scenario, the proximity is very much larger than when the magnets repelled. Thus, the system has been "re-set" and is prepared to engage the magnets again.

The outer driver can either drive away and not stop, or drive away, stop, return to some intermediate position and pick up the inner driver, and then drive away. This intermediate position can be defined in the software, and can be set by the user. This intermediate position is where the magnets are proximate to the point that the force between them can move the inner driver out of the cup.

The magnets maintain a repelling force while the swivel magnet is moving to the open position. Speed is still a factor, but in specific embodiments, speed is not the only factor as to whether the outer driver couple set the inner driver. The magnets are switching between a repelling state and an attracting state by using the magnetic field between poles (around the edges of the physical magnet) to pivot the swivel magnet in and out of attraction.

The automatic engagement allows both draperies to be moved as one of the shades to be moved manually with a rod or the shade, and once the movement is complete, the motor can rotate the drive element or the drapery drive tube can be manually rotated with a draw cord. In an embodiment, both draperies can be moved as appropriate via the motor, and can be moved together with the motor, and one of the draperies can be moved by the motor or by hand. A specific embodiment can allow the sheer drapery to be manually moved by conventional mechanism, such as with a rod or by hand, where the sheer drapery can be slid along the track much like with a conventional curtain rod.

In an embodiment, by allowing different curtains to be moved by the same drive element, two curtains, such as a sheer drapery and a blackout drapery, can be operated such that neither are covering the window, the sheer drapery is covering the window, or both the sheer drapery and the blackout drapery are covering the window. This can be reversed if the sheer and the blackout draperies are reversed. In an embodiment, the sheer drapery can be translucent and the blackout drapery can be opaque.

One or more grooves, such as helical grooves, that intercoupled with the attachment elements that are driven by the one or more grooves to move the draperies can be formed into the drapery or drive element or formed into a sleeve that is positioned over the drive element.
Both clockwise and counter clockwise grooves can be formed into the same drive element or sleeve.

In a preferred embodiment, all drive components, controls, and the power source can be internal to the drapery tube or drive element. Storing the drive components, the controls, and the power supply internal to the support tube can efficiently utilize the space required for a motorized shade, can reduce or eliminate the need for belt and track assemblies used in current technology, and can also eliminate the need for a motor mounting on one end of the shade assembly.

The drapery system can incorporate one or more guide tracks for one or both of the two draperies, where both draperies are driven by a common driver.

Specific embodiments employ the drive system with a center opening shade system, where the single sets of shades meet in the middle of the opening. The black-out shades can compress the stored sheer shades and overlap with the sheer shades such that no space between the shades is visible and the system does not allow light to show through into the room.

The design of the system can allow a simple cut-down ability, by, for example, removing an end cap and cutting the drapery tube. The ability to easily cut down the length of the tube allows the system to fit into narrower windows.

Embodiments can prevent a gap in the center of the window with an open center system using dual tubes sets of shades. In an embodiment, center opening sets of shades can have a motorized drive element and one motor, where movement of the curtains on the drive element in opposite directions (e.g., left to right and right to left) can be accomplished by having grooves having opposite handed rotation (e.g., right vs. left, or clockwise vs. counter clockwise) on the drive element and rotating the motor in the same direction. In a specific embodiment, the motorized drive element or sleeve can have double formed helixes in both the clockwise and counterclockwise direction. In a specific embodiment, clockwise grooves on the portion of the drive element on one side of center and counterclockwise grooves on the drive element on the other side of center can be used to move the curtain on one side of center in a first direction and the curtain on the other side of center in the opposite direction of rotation of the drive element. The drive element can then be rotated in the opposite direction to move the curtains in the opposite direction. Again, an embodiment can have one motor, one controller, and one power supply to drive the drive element on both sides of center. When the same portion of the drive element has both clockwise and counter clockwise
grooves, the drive element can be used on either side of center and can, therefore, reduce the
deal to keep two types of drive element in stock and to keep same organized. Further, such
drive elements with two clockwise and counterclockwise grooves can be used for right hand,
left hand, and/or center opening shade systems, by selection of the appropriate drive and lead
attachment elements.

Referring to Figs 64-67 the motorized assembly can be powered by a battery pack internal to the drive elements 114 and 115, a battery tube 101 attached to an end bracket, a battery tube 101 attached to the wall of a structure with a bracket 106, or a battery tube 101 attached somewhere else. There can also be a low voltage transformer supplying power to the outer draperies as known in the art. The draperies are hung from the outer drapery clips 119, which are positioned and moved in the cover track 111, track III, and the inner draperies are hung from the inner drapery clips 118 which are positioned and moved in the cover track 111 track III. There are also outer driven clips 117 driven along the track III by the outer driver 120 and inner driven clips 116 driven along the track III.

Although a center open track assembly is shown in Figures 64-69 and 78-77, the right hand side of the assembly shown in Figures 64-69 and 76-77 can be for a right hand drapery and the left hand side of the assembly shown in Figures 64-65 and 76-77 can be for a right hand drapery, within the intent of this disclosure.

The drapery assembly can be mounted over an opening with brackets as shown, or via a variety of methods, as known in the art.

Referring to Fig 69, the end of each drive element ending in the middle is shown. This end can be opposite the motor or end bearing assembly 139. In a preferred embodiment, tubes 114, 115 have a keyed insert 127 into which a bearing 128 fits. The bearings are permanently mounted on the end plates 112 on an extruded hole 140. The bearing allows tubes 114, 115 to rotate with minimal friction. A drive gears and shaft assembly 129 connects each keyed insert 127 to the other, through the center of the extruded hole 140 on the end brackets 112. In this way, rotation of one of the tubes 114, 115 will cause the rotation of the other tube 114, 115.

Referring to Figs 70-74, which show a top view of the inner curtain driver 22 with a portion of the cover track 11 cut away, the inner drivers 122 and 123, outer drivers 120 and 121, and inner driver cups 125 and 126 all work together to connect and disconnect the outer drapery from the inner drapery. Such connection and disconnection utilizes magnets and control of their relative orientation, and location, and movement of the outer drivers either below a critical speed or above the critical speed during a certain portion of the connecting
and disconnecting process. The outer drivers 120 and 121 have a small pivoting magnet 124 that works with a corresponding inner driver 122 and 123 that has a stationary magnet 135. When connected, magnet 124 and magnet 135 face each other with opposite poles.

As the outer drivers 120, 121 drive toward the center of the assembly (end brackets 112), the inner driver 122, 123 is pushed along until it reaches a cut-out 141 in the guide extrusion. Within the cut-out 141 sits the inner driver cups 125 and 126. The outer drivers 120 and 121 press the inner drivers 122, 123 against the protruding leg of the inner driver 122 and 123, and the force of the outer drivers 120 and 121 push the inner drivers 122 and 123 into the cups 125 or 126. The magnets 124 and 135 are sheared apart during this movement. The outer driver 120 or 121 then continues to move with respect to the inner driver 122 or 123, and the pivoting magnet is repelled by the inner driver's magnet 135 (see Figure 70).

In this state, the outer driver 120 or 121 can either drive away quickly (above a critical speed and the magnets being in a repelling state) and leave the inner driver 122 or 123 behind (see Figure 71), or drive back slowly (below a critical speed and the magnets being in an attraction state) and pick up the inner driver 122, 123 allowing the magnets 124 and 135 to align and attach (see Figure 72). The magnets 124 and 135 will re-align depending on the speed with which the outer driver 120 or 121 moves with respect to the inner driver 122 or 123 and which relative orientation of the magnets are in.

In the embodiment shown in Figures 64-77, when the outer drapery is in the open position and the inner drapery is left closed, the inner drapery is free to be operated manually.

Magnets 124 and 135 are sufficiently weak such that as soon as the magnets start pulling the inner drapery to open, the force overcomes the magnetic attraction of the magnets, disengaging magnet 124 from magnet 135, such that the outer driver 120 or 121 slides forward a small distance and engages the inner driver hook 138 moving the inner driver 122 or 123 to travel the rest of the distance to open the inside drapery (see Figure 73).

At the point when the user wants only the inner curtain closed, both the inner and outer curtains are moved back towards the center and the position where the curtains are fully closed and hard stopped (see Figure 70). In this position the two magnets 124 and 135 are mechanically separated with the inner driver 122 or 123 pushed into the cutout in the track 141 and in the cup 125 or 126 with the swivel magnet 124 turned approximately 180 degrees from the stationary magnet 135. Also, in this position, as the inner driver 122 or 123 with the hook 138 and stationary magnet 135 are pushed into a plastic cup 125 or 126, the inner driver 122, 123 is shifted out of the pathway of the outer driver 120 or 121 that is holding the
swiveling magnet 124. Accordingly, when it is desired to return the outer curtain to the open position and leave the inner curtain closed, the outer driver 120 or 121, which is attached to the outside curtain, can be moved fast enough with respect to the inner driver 122, 123 that the swiveling magnet 124 does not have enough time to attract the inner driver 122 or 123 with the stationary magnet 135, and, consequently, the magnet 124 and the magnet 135 does not get attached and the inner curtain is left behind in the closed position.

In another specific embodiment, the structure of the assembly shown in Figures 64-77 can be reconfigured such that the outer curtain is left in the closed position when the inner curtain driver is moved at a speed above the critical speed past the outer curtain driver to open the inner curtain and leave the outer curtain in the closed position. Such a modification can be applied to center open, right open, and left open curtain systems. Such an embodiment can have a sheer curtain as the outer curtain and a blackout curtain as the inner curtain, or other pairs of curtains, as known in the art. Having the sheer curtain as the outer curtain can allow the curtain system to take up less space, e.g. protrude away from the window a smaller distance, and also allow the sheer curtain to close with the blackout curtain and allow the blackout curtain to be closed with the sheer open.

The features described herein and the features illustrated in Figures 64-77 can be used to create one or more of the following:

A system for the horizontal movement of at least one set of at least two vertical curtains or draperies that have a common drive element driven by the rotation of a helix in the outer surface of a rotatable tube applying a horizontal movement force on at least one drive element attached to the drapery and guided by at least one guide rail, where there are at least one drive attachment element and magnets are used to select the draperies to move.

A system horizontal movement of at least one set of vertical curtains or draperies, where the drive element is a rod.

A system horizontal movement of at least one set of vertical curtains or draperies, where the drive element is a tube.

A system horizontal movement of at least one set of vertical curtains or draperies, where the drive element is motorized.

A horizontal moving set of curtains or draperies made from dissimilar materials and can be operated individually with a common rotating drive system.
A system for the horizontal movement of at least one set of vertical curtains or draperies, where the drive section of the rotational drive element has at least one helix formed into the outer surface.

A system of motorized horizontal movement of at least one set of vertical curtains or draperies, where the motorized unit is battery powered and has a wireless receiver on the control board.

A system for the horizontal movement of at least one set of vertical curtains or draperies, where a manual operation is provided with a pull cord that rotates the rotatable drive member.

A system of motorized horizontal movement of at least one set of vertical curtains or draperies, where the motor is positioned internal to the drive tube.

A system of motorized horizontal movement of at least one set of vertical curtains or draperies, where the power supply is positioned internal to the drive tube.

A system for the horizontal movement of at least two sets of vertical curtains or draperies by the rotation of a helix in the outer surface of a rotatable drive element applying a movement force on a toothed drive attachment element for moving the draperies, where there are at least one drive attachment element and multiple non-driving attachment elements that are guided by at least one guide rail and suspend the draperies.

A system for the horizontal movement of at least two sets of vertical curtains or draperies by the rotation of a pitch thread mentioned above where there are at least two pitch threads, one being formed clockwise and one being formed counter clockwise and the drive tooth in the drive attachment element and the lead attachment element is angled to maintain engagement with the drive tube.

A system of motorized horizontal movement of at least two vertical curtains or draperies, positioned on different portions of the drive element, by the rotation of a pitch threads, where a single motor moves curtains on a first portion of the drive element and curtains on a second portion of the drive element in opposite directions.

A system of motorized horizontal movement of at least two vertical curtains or draperies by the rotation of a tube with a formed pitched thread, where a power supply can be external to the tube and enters through at least one of the support shafts.

Aspects of the invention, such as controlling the motor, may be described in the general context of computer-executable instructions, such as program modules, being executed by a computer. Generally, program modules include routines, programs, objects,
components, data structures, etc., that perform particular tasks or implement particular abstract data types. Moreover, those skilled in the art will appreciate that the invention may be practiced with a variety of computer-system configurations, including multiprocessor systems, microprocessor-based or programmable-consumer electronics, minicomputers, mainframe computers, and the like. Any number of computer-systems and computer networks are acceptable for use with the present invention.

Specific hardware devices, programming languages, components, processes, protocols, and numerous details including operating environments and the like are set forth to provide a thorough understanding of the present invention. In other instances, structures, devices, and processes are shown in block-diagram form, rather than in detail, to avoid obscuring the present invention. But an ordinary-skilled artisan would understand that the present invention may be practiced without these specific details. Computer systems, servers, work stations, and other machines may be connected to one another across a communication medium including, for example, a network or networks.

As one skilled in the art will appreciate, embodiments of the present invention may be embodied as, among other things: a method, system, or computer-program product. Accordingly, the embodiments may take the form of a hardware embodiment, a software embodiment, or an embodiment combining software and hardware. In an embodiment, the present invention takes the form of a computer-program product that includes computer-useable instructions embodied on one or more computer-readable media.

Computer-readable media include both volatile and nonvolatile media, transient and non-transient media, removable and nonremovable media, and contemplate media readable by a database, a switch, and various other network devices. By way of example, and not limitation, computer-readable media comprise media implemented in any method or technology for storing information. Examples of stored information include computer-useable instructions, data structures, program modules, and other data representations. Media examples include, but are not limited to, information-delivery media, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile discs (DVD), holographic media or other optical disc storage, magnetic cassettes, magnetic tape, magnetic disk storage, and other magnetic storage devices. These technologies can store data momentarily, temporarily, or permanently.

The invention may be practiced in distributed-computing environments where tasks are performed by remote-processing devices that are linked through a communications
In a distributed-computing environment, program modules may be located in both local and remote computer-storage media including memory storage devices. The computer-useable instructions form an interface to allow a computer to react according to a source of input. The instructions cooperate with other code segments to initiate a variety of tasks in response to data received in conjunction with the source of the received data.

The present invention may be practiced in a network environment such as a communications network. Such networks are widely used to connect various types of network elements, such as routers, servers, gateways, and so forth. Further, the invention may be practiced in a multi-network environment having various, connected public and/or private networks.

Communication between network elements may be wireless or wireline (wired). As will be appreciated by those skilled in the art, communication networks may take several different forms and may use several different communication protocols. And the present invention is not limited by the forms and communication protocols described herein.

All patents, patent applications, provisional applications, and publications referred to or cited herein are incorporated by reference in their entirety, including all figures and tables, to the extent they are not inconsistent with the explicit teachings of this specification.

It should be understood that the examples and embodiments described herein are for illustrative purposes only and that various modifications or changes in light thereof will be suggested to persons skilled in the art and are to be included within the spirit and purview of this application.
REFERENCE NUMBERS

1 dual curtain assembly
3 outer driver carrier attachment post
4b first inner drive tooth
4a second inner drive tooth
5a first outer drive tooth
5b second outer drive tooth
6 outer carrier attachment post
7 motor control circuit board
9 inner drive element
10 drive element
11 support guide
12 outer curtain carrier track
13 rubber mounting disk
14 pin hook
15 inner driver stall area
17 S hooks
18 axles
20 curtain assembly
21 batteries
22 drive element
23 right outer curtain drive attachment element
24 helical guide structure
25 right inner curtain drive element
26 outer surface
27 motor drive adapter
28 slip ring
29 inter-curtain engager catch
30 pull cord
31 inner carrier attachment post
32 motor assembly
33 rotation assembly
34 window
35 motor end
36 driver attachment element
36A outer driver attachment element
36B inner driver attachment element
37 loop
38 clockwise helical groove
39 Loop
40 counter clockwise helical groove
42 Center
43 external power supply
44A outer curtain
44B inner curtain
45 wall bracket
46 center closing curtain
47 battery sleeve
48 left panel
49 intercurtain engager
50 right panel
end cap
Axles
motor housing
end brackets
aperture
outer diameter
bearing housing
motor end
bearings end
longitudinal axis
inner tube
driver tooth
sleeve/outer tube
non-driven end
fractal antenna
driven end
idler attachment element
outer curtain idler attachment element
attachment point
outer curtain carrier
draw rod
outer tooth drive
pull cord
inner tooth drive
left driver attachment element
o-ring
right driver attachment element
outer drive tube
left draw rod
right draw rod
inner curtain carrier track
motor
batteries
battery tube
motor output shaft
first lead tooth
second lead tooth
ball bearing
motor drive adapter
inner curtain carrier
bearings
finial
remote control
receiver for draw rod
button
receiver for hook
outer driver stall area
battery tube
battery
spring
battery tube end cap
105 o-ring
106 battery tube wall bracket
107 battery tube connector cap
108 s-hook
109 mounting bracket
110 bracket clip
111 cover track
112 track end plates
113 fasteners
114 tube CW
115 tube CCW
116 inner driver hanger clip
117 outer driver hanger clip
118 inner hanger clips
119 outer drapery clips
120 outer driver CW
121 outer driver CCW
122 inner driver w/magnet CW
123 inner driver w/magnet CCW
124 swivel magnet
125 inner driver cup CW
126 inner driver cup CCW
127 tube cap center bearing
128 center bearing
129 drive gears and shaft assembly
130 drive shafts
131 drive shaft retainers
132 end tube bearing housings
133 antenna assembly
134 end tube caps
135 stationary magnet
136 groove in tube
137 driver protrusion
138 inner driver hook
139 end bearing assembly
140 end plate extruded hole
141 cutout in track
What is claimed is:

1. A window covering assembly, comprising:
   a drive element;
   the drive element extending a length between a first end and a second end;
   the drive element having an exterior surface;
   the exterior surface having a guide structure;
   a first drive attachment element operatively connected to the drive element and in
   communication with the guide structure;
   a first driver coupled to the first drive attachment element;
   a second driver removably coupled to the first drive attachment element;
   a first curtain having a first end and a second end of the first curtain, wherein the first
   end of the first curtain is connected to the first driver; and
   a second curtain having a first end and a second end of the second curtain, wherein
   the second end of the second curtain is operatively connected to the second driver,
   wherein when the drive element is rotated the first curtain and second curtain are
   opened or closed.

2. The window covering assembly of any preceding claim, wherein the drive
   element is generally cylindrical in shape.

3. The window covering assembly of any preceding claim, wherein the guide
   structure includes a pair of clockwise helical grooves.

4. The window covering assembly of any preceding claim, wherein the guide
   structure includes a pair of clockwise helical grooves spaced approximately 180 degrees apart
   from one another.

5. The window covering assembly of any preceding claim, wherein the guide
   structure includes a pair of counterclockwise helical grooves.
6. The window covering assembly of any preceding claim, wherein the guide structure includes a pair of counterclockwise helical grooves spaced approximately 180 degrees apart from one another.

7. The window covering assembly of any preceding claim, wherein the guide structure includes a pair of clockwise helical grooves and a pair of counterclockwise helical grooves.

8. The window covering assembly of any preceding claim, wherein a rotation assembly is positioned within the drive element.

9. The window covering assembly of any preceding claim, wherein a motor assembly is positioned within the drive element.

10. The window covering assembly of any preceding claim, wherein a power supply is positioned within the drive element.

11. The window covering assembly of any preceding claim, wherein a plurality of batteries are positioned within the drive element.

12. The window covering assembly of any preceding claim, wherein the drive element is activated by cell phone.

13. The window covering assembly of any preceding claim, wherein the drive element is activated by a remote.

14. The window covering assembly of any preceding claim, wherein the drive element is activated by a tug.

15. The window covering assembly of any preceding claim, wherein the drive element is activated by voice command into a transmitter.
16. The window covering assembly of any preceding claim, wherein the drive attachment element is positioned around the drive element.

17. The window covering assembly of any preceding claim, wherein the drive attachment element has a tooth that engages a groove of the guide structure.

18. The window covering assembly of any preceding claim, wherein the first curtain is operatively connected to a plurality of first hanger clips slidably interconnected with a first cover track.

19. The window covering assembly of any preceding claim, wherein the guide structure includes a helical groove that is spaced between 1 and 6 inches from itself along the length of the drive element.

20. The window covering assembly of any preceding claim, wherein a second curtain is operatively connected to a plurality of second hanger clips slidably interconnected with a second cover track.

21. The window covering assembly of any preceding claim, further comprising a third curtain operatively connected to the drive element such that when the drive element is rotated the first curtain and third curtain simultaneously open or close.

22. The window covering assembly of any preceding claim, wherein the window covering assembly is center closing.

23. The window covering assembly of any preceding claim, wherein the guide structure includes at least one helical groove, one or more of the at least one helical groove extending at an angle to a cross-sectional plane of the drive element, wherein the angle is between 10 and 80 degrees.

24. The window covering assembly of any preceding claim, wherein the guide structure includes at least one helical groove, one or more of the at least one helical groove
extending at an angle to a cross-sectional plane of the drive element, wherein the angle is approximately 45 degrees.

25. The window covering assembly of any preceding claim, wherein the drive element is connected to a bracket by an axel such that when the drive element is rotated the axel remains stationary.

26. The window covering assembly of any preceding claim, wherein a draw rod is connected to the first drive attachment element.

27. The window covering assembly of any preceding claim, wherein the window covering assembly includes a sensor or detector that stops rotation of the drive element when actuated.

28. The window covering assembly of any preceding claim, wherein communication of the first drive attachment with the guide translates rotation of the drive element into the first curtain and second curtain opening or closing.

29. A window covering assembly, comprising:
a drive element;
the drive element extending a length between a first end and a second end;
the drive element having an exterior surface;
the exterior surface having a guide structure;
a first drive attachment element and a second drive attachment element operatively connected to the drive element and in communication with the guide structure;
a first driver coupled to the first drive attachment element;
a second driver removably coupled to the first drive attachment element;
a third driver coupled to the second drive attachment element;
a fourth driver removably coupled to the second drive attachment element;
a first curtain having a first end and a second end of the first curtain, wherein the first end of the first curtain is operatively connected to the first driver;
a second curtain having a first end and a second end of the second curtain, wherein the second end of the second curtain is operatively connected to the second driver;
a third curtain having a first end and a second end of the third curtain, wherein the second end of the third curtain is operatively connected to the third driver; and

a fourth curtain having a first end and a second end of the fourth curtain, wherein the second end of the fourth curtain is operatively connected to the fourth driver,

wherein when the drive element is rotated the first curtain, second curtain, third curtain, and fourth curtain are opened or closed.

30. The window covering assembly according to claim 29, wherein the guide structure is formed of a pair of clockwise helical grooves and a pair of counterclockwise helical grooves,

31. The window covering assembly of claim 30, wherein the pair of clockwise helical grooves are positioned on opposite sides of the drive element from one another, and wherein the pair of counterclockwise helical grooves are positioned on opposite sides of the drive element from one another.

32. The window covering assembly of claim 30, wherein the first drive attachment element is in communication with the pair of clockwise helical grooves or the pair of counterclockwise helical grooves and the second driver attachment element is in communication the other of the pair of clockwise helical grooves or the pair of counterclockwise helical grooves.

33. The window covering assembly of claim 29, wherein the first drive attachment element has a pair of teeth which engage either the pair of clockwise helical grooves or the pair of counterclockwise helical grooves.

34. A window covering assembly, comprising:

a drive element having at least one guide structure formed on or into an outer surface of the drive element;

a drive attachment element having a corresponding drive structure that communicates with one or more of the at least one guide structure to move the drive attachment element axially along the drive element when the drive element is rotated about a longitudinal axis of the drive element;
a first curtain having a first end of the first curtain and a second end of the first curtain, wherein the first curtain is connected to a first driver, wherein the first driver is coupled to the drive attachment such that when the drive attachment element is moved axially along the drive element by rotating the drive element, the first driver is moved by the drive attachment;

a second curtain having a first end of the second curtain and a second end of the second curtain, wherein the second end of the second curtain is attached to a second driver, wherein the second driver is removably coupled to the drive attachment element such that, when the second driver is coupled to the drive attachment element, the second driver is moved by the drive attachment element when the drive attachment element is moved axially along the drive element by rotating the drive element, and when the second driver is decoupled from the drive attachment element, the second driver is not moved by the drive attachment element when the drive attachment element is moved axially along the drive element by rotating the drive element;

wherein movement of the drive attachment element from a first position on the drive element to a second position on the drive element moves the first driver from the first position on the drive element to the second position on the drive element,

wherein movement of the drive attachment element from the first position on the drive element to the second position on the drive element, when the second driver is coupled to the drive attachment element, moves the second driver from the first position on the drive element to the second position on the drive element,

wherein movement of the drive attachment element from the second position on the drive element to the first position on the drive element moves the first driver from the second position on the drive element to the first position on the drive element,

wherein movement of the drive attachment element from the second position on the drive element to the first position on the drive element, when the second driver is decoupled from the drive attachment element, does not move the second driver,

wherein moving the drive attachment element from the first position on the drive element to the second position on the drive element and/or moving the drive attachment element from the second position on the drive element to the first position on the drive element, and coupling, or decoupling, the second driver to, or from, the drive attachment element, allows the second end of the first curtain and/or the second end of the second curtain to be moved from the first position on the drive element to the second position on the drive element.
element and/or the second end of the first curtain and/or the second end of the second curtain to be moved from the second position on the drive element to the first position on the drive element, such that each of three states can be achieved, wherein the first state is the second end of the first curtain and the second end of the second curtain are positioned at the second position on the drive element, a second state is the second end of the first curtain is positioned at the first position on the drive element and the second end of the second curtain is positioned at the second position on the drive element, and the third state is the second end of the first curtain and the second end of the second curtain are positioned at the first position on the drive element.

35. The window covering assembly according to claim 1, further comprising a rotation assembly for rotating the drive element.

36. The window covering assembly according to any of claims 34-35, wherein the drive element is a tube.

37. The window covering assembly according to any of claims 34-36, wherein at least a portion of the drive element is hollow, wherein the outer surface of the drive element has a circular cross-sectional shape.

38. The window covering assembly of any of claims 34-37, wherein the at least one guide structure comprises a helical guide structure.

39. The window covering assembly according to claim 38, wherein the helical guide structure comprises a helical groove formed into the outer surface of the drive element.

40. The window covering assembly according to any of claims 34-39, wherein the at least one corresponding drive structure comprises a tooth.

41. The window covering assembly according to claim 39, wherein the helical groove is axially spaced between 2 inches and 6 inches from itself along the drive element.
42. The window covering assembly according to any of claims 34-41, wherein when the drive attachment element is at the first position on the drive element and the second driver is decoupled from the drive attachment element, and the second end of the second curtain is positioned at the second position on the drive element, a user can move the second end of the second curtain without rotating the drive element.

43. The window covering assembly according to any of claims 35-42, wherein the rotation assembly comprises a motor.

44. The window covering assembly according to claim 43, wherein the motor is mounted inside the drive element.

45. The window covering assembly according to any of claims 43-44, further comprising a power supply for the motor, wherein the power supply is mounted inside the drive element.

46. The window covering assembly according to any of claims 43-45, wherein the motor is battery powered.

47. The window covering assembly of any of claims 43-46, wherein the rotation assembly further comprises a control board and a wireless receiver that can receive a signal from a transmitter to operate the motor.

48. The window covering assembly according to any of claims 35-47, wherein the rotation assembly comprises a pull cord connected to the drive element to manually rotate the drive element.

49. The window covering assembly according to any of claims 35-47, wherein the motor is operated by a voice command into a transmitter or by key strokes using a device selected from the group consisting of: a remote control, a cell phone, a personal data assistant, or a personal computer.
50. The window covering assembly according to any of claims 34-49, wherein the first end of the first curtain is fixed and the first end of the second curtain is fixed.

51. The window covering assembly according to any of claims 34-50, further comprising:
   a first cover track;
   a plurality of first hanger clips, wherein the plurality of first hanger clips are attached to the first curtain between the first end of the first curtain and the second end of the first curtain, wherein the plurality of first hanger clips are slidably interconnected with the first cover track such that the first cover track supports a portion of the first curtain, wherein when the drive element moves the drive attachment element so as to move the second end of the first curtain each of the first hanger clips of the plurality of first hanger clips slide with respect to the first cover track to allow the first curtain to be moved.

52. The window covering assembly according to any of claims 34-50, further comprising:
   a second cover track;
   a plurality of second hanger clips, wherein the plurality of second hanger clips are attached to the second curtain between the first end of the second curtain and the second end of the second curtain, wherein the plurality of second hanger clips are slidably interconnected with the second cover track such that the second cover track supports a portion of the second curtain, wherein when the drive element moves the drive attachment element so as to move the second end of the second curtain each of the second hanger clips of the plurality of second hanger clips slide with respect to the second cover track to allow the second curtain to be moved.

53. The window covering assembly according to claim 51, further comprising:
   a second cover track;
   a plurality of second hanger clips, wherein the plurality of second hanger clips are attached to the second curtain between the first end of the second curtain and the second end of the second curtain, wherein the plurality of second hanger clips are slidably interconnected with the second cover track such that the second cover track supports a portion of the second curtain, wherein when the drive element moves the drive attachment element so as to move
the second end of the second curtain each of the second hanger clips of the plurality of second hanger clips slide with respect to the second cover track to allow the second curtain to be moved.

54. The window covering assembly according to any of claims 34-53, wherein rotating the drive element clockwise move the drive attachment element in a first axial direction along the drive element, wherein rotating the drive element counter-clockwise moves the drive attachment element in a second axial direction along the drive element, wherein the second axial direction is opposite to the first axial direction.

55. The window covering assembly according to any of claims 34-54, further comprising:

a second drive attachment element having a corresponding second drive structure that communicates one or more of the at least one guide structure to move the second drive attachment element axially along the drive element when the drive element is rotated about the longitudinal axis of the drive element, wherein when the second drive element is rotated about the longitudinal axis of the drive element the second drive attachment element moves in a second axial direction that is opposite to the axial direction the drive attachment element moves,

a first additional curtain having a first additional end of the first additional curtain and a second additional end of the first additional curtain, wherein the first additional curtain is connected to a first additional driver, wherein the first additional driver is coupled to the second drive attachment such that when the second drive attachment element is moved axially along the drive element by rotating the drive element, the first additional driver is moved by the second drive attachment;

a second additional curtain having a first additional end of the second additional curtain and a second additional end of the second additional curtain, wherein the second additional end of the second additional curtain is attached to a second additional driver, wherein the second additional driver is removably coupled to the second drive attachment element such that, when the second additional driver is coupled to the second drive attachment element, the second additional driver is moved by the second drive attachment element when the second drive attachment element is moved axially along the drive element by rotating the drive element, and when the second additional driver is decoupled from the
second drive attachment element, the second additional driver is not moved by the second drive attachment element when the second drive attachment element is moved axially along the drive element by rotating the drive element;

wherein movement of the second drive attachment element from a first additional position on the drive element to a second additional position on the drive element moves the first additional driver from the first additional position on the drive element to the second additional position on the drive element,

wherein movement of the second drive attachment element from the first additional position on the drive element to the second additional position on the drive element, when the second additional driver is coupled to the second drive attachment element, moves the second additional driver from the first additional position on the drive element to the second additional position on the drive element,

wherein movement of the second drive attachment element from the second additional position on the drive element to the first additional position on the drive element moves the first additional driver from the second additional position on the drive element to the first additional position on the drive element,

wherein movement of the second drive attachment element from the second additional position on the drive element to the first additional position on the drive element, when the second additional driver is decoupled from the second drive attachment element, does not move the second additional driver,

wherein moving the second drive attachment element from the first additional position on the drive element to the second additional position on the drive element and/or moving the second drive attachment element from the second additional position on the drive element to the first additional position on the drive element, and coupling, or decoupling, the second additional driver to, or from, the second drive attachment element, allows the second additional end of the first additional curtain and/or the second additional end of the second additional curtain to be moved from the first additional position on the drive element to the second additional position on the drive element and/or the second additional end of the first additional curtain and/or the second additional end of the second additional curtain to be moved from the second additional position on the drive element to the first additional position on the drive element, such that each of three additional states can be achieved, wherein the first additional state is the second additional end of the first additional curtain and the second additional end of the second additional curtain are positioned at the second
additional position on the drive element, a second additional state is the second additional end of the first additional curtain is positioned at the first additional position on the drive element and the second additional end of the second additional curtain is positioned at the second additional position on the drive element, and the third additional state is the second additional end of the first additional curtain and the second additional end of the second additional curtain are positioned at the first additional position on the drive element.

56. The window covering assembly according to claim 55, wherein the assembly is a center closing assembly, wherein the first curtain and second curtain are on a left side, wherein the first additional curtain and second additional curtain are on a right side.

57. The window covering assembly according to any of claims 34-56, wherein the first curtain is connected to the first driver via a first driver hanger clip.

58. The window covering assembly according to any of claims 34-57, wherein the second curtain is connected to the second driver via a second driver hanger clip.

59. The window covering assembly according to any of claims 34-58, wherein the drive attachment element has a first magnet, where the second driver has a second magnet, wherein coupling the second driver to the drive attachment element is accomplished by bringing the second driver into proximity to the drive attachment element while a speed of the second driver relative to the drive attachment element is below a critical speed such that an attraction of the first magnet to the second magnet can effect such coupling.

60. The window covering assembly according to claim 26, wherein decoupling the second driver from the drive attachment element is accomplished by the drive attachment element pushing the second driver into an object such that a force is created on the second driver to move away from the drive attachment element such that the second driver is decoupled from the drive attachment element.

61. A window covering assembly, comprising:

- a drive element;
- the drive element extending a length between a first end and a second end;
the drive element having an exterior surface;
the exterior surface having a guide structure;
a first drive attachment element operatively connected to the drive element and in communication with the guide structure;
a first curtain operatively connected to the first drive attachment element; and a sensor,

wherein when the drive element is rotated the first curtain is opened or closed, wherein the sensor detects a force and/or torque applied to the window covering system, wherein when the sensor detects the force and/or torque applied to the window covering system, the sensor activates the window covering system to open or close the first curtain.

62. The window covering system according to claim 61, wherein the sensor comprises an accelerometer.
FIG. 63B
FIG. 63G
MOVE TO POSITION X

Position X equals 25%  
Yes → Goto MOVE25

No

Position X equals 50%  
Yes → Goto MOVE50

No

Position X equals 75%  
Yes → Goto MOVE75

No

Goto MainLoop

FIG. 631
Set Start Position

Watch for user interaction timer timeout or user interaction.

Was a Remote Programmed or a learned remote fired? No

Did the user interaction timer timeout?

Yes

No

Move down to predetermined position.

Arrived at target position?

Yes

Stop shade movement. Wait for user input or user interaction timer timeout.

Was the shade tugged?

No

Yes

Did the user interaction timer timeout or was a learned remote fired?

No

Yes

Reset user interaction timer. Wait for remote response or timeout.

Did the user hit a remote?

No

Yes

Did the user interaction timer timeout?

No

Yes

Count Distance to top and set this as the curtain limit. Save lower limit to EEPROM.

Continue normal shade operation.

Use the lower limit stored in EEPROM upon a successful hardstop.

Go to MainLoop

FIG. 63L
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

E06B 9/24(2006.01), E06B 9/36(2006.01)

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)
E06B 9/24; E06B 5/00; E06B 3/32; A47H 5/02; A47H 5/00; A47H 5/08; E06B 9/36

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: drapery panel, window covering assembly, drive element, curtain, helical groove, and sensor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>Y</td>
<td>K[10-0903201 BI (FEELUX CO., LTD.) 18 June 2009 See paragraphs [0029]-[0032], [0040], [0056]H0064] and figures 1-6.</td>
<td>61-62</td>
</tr>
<tr>
<td>A</td>
<td>JP 2009-034301 A (TOYOTA MOTOR CORP.) 19 February 2009 See paragraph [0023] and figure 1.</td>
<td>1-2, 29-36, 61-62</td>
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</table>

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 application or patent but 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
  "Q" 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
  "R" 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
  "S" 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

Date of the actual completion of the international search
24 January 2014 (24.01.2014)

Date of mailing of the international search report
24 January 2014 (24.01.2014)

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Form PCT/ISA/2.10 (second sheet) (July 2009)
INTERNATIONAL SEARCH REPORT

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
   - because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 39,41,44,53,56,60
   - because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
     - Claims 39,41,44,53,56,60 are unclear, because they refer to multiple dependent claims which do not comply with PCT Rule 6.4(a).

   - because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☒ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.
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<th>Patent document cited in search report</th>
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