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COVERING ASSEMBLY FOR ARCHITECTURAL OPENINGS

5 The present invention relates to a covering assembly particularly for windows, doors and other architectural openings.

There are many known forms of covering assemblies for windows, doors and the like including curtains, roller blinds, venetian blinds, drapery and the like. Recently there has been proposed a window covering assembly which includes a first and second generally parallel spaced apart vertically extending sheer fabrics having a plurality of spaced generally parallel transversely extending vanes fixedly secured to the first and second sheer fabrics to extend therebetween.

15 The sheer fabrics are often constructed of a translucent or transparent material and may be in the form of woven or knitted fabrics or non-woven fabrics or indeed may simply be sheets of plastics material. The vanes are usually opaque or semi-opaque and by adjusting the relative positions of the sheer fabrics, the vanes can be caused to tilt relative to the sheer fabrics rather in the manner of the slats of a horizontal or vertical blind. Conventionally the vanes extend horizontally in such assemblies and the sheer fabrics are supported on a tilt roll which can also be used as a wind up roll. Also known are vertical venetian blinds in which the individual vanes extend vertically; such assemblies have a head rail for opening and closing the assembly and for tilting the vanes when the assembly is in the closed position covering the opening.

30 It is a primary object of the present invention to provide a novel covering assembly that will have all of the attributes and advantages of a vertical blind while having all the attributes and advantages of drapery.

35 The foregoing is accomplished by providing a vertically oriented fabric assembly with front and rear sheers and vertically disposed vanes extending therebetween. A unique carrier system supports the front and rear sheers

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to enable them to shift from a maximum light admitting orientation to a minimum light admitting orientation by rotating the vanes about vertical axes. The carrier system also enables the panels of the assembly defined as a vane and the juxtaposed portions of the front and rear sheers, to collapse and fold up upon themselves much like conventional drapery. A further important feature of the present invention is that the front and rear sheers should have diagonal stability so that when the vanes are operated, by one means or another, at the top, the diagonal stability ensures that the vanes operate equally well at their bottoms.

In order that the present invention may more readily be understood, the following description is given, merely by way of example, reference being made to the accompanying drawings in which:-

Figure 1 is a schematic perspective view of one embodiment of fabric light window covering used in a light control assembly of the present invention;

Figures 1a and 1b show (as viewed under the microscope) two different forms of sheer fabric material suitable for use with the assembly of Figure 1;

Figure 2 is a perspective view of a head rail and one embodiment of carrier used for mounting the covering of Figure 1;

Figure 3 is a schematic side elevation showing how a sheer fabric is mounted on a hanger of a carrier of Figure 2;

Figure 4 is a plan view of a carrier of Figure 2;

Figure 5 is a schematic top plan view showing the fabric covering open and where the hanger of the carrier is attached to the sheer fabric;

Figure 6 is a schematic top plan view showing the fabric covering nearly closed;

Figure 7 is a schematic top plan view showing the fabric covering over-closed;

Figure 8 is a schematic top plan view showing the



fabric covering collapsed or drawn back state;

Figure 9 is a schematic top plan view showing the over-closed position of Figure 7 in enlarged detail;

Figure 10 is an elevational view, part broken away
5 of a modified carrier assembly;

Figure 11 is a sectional elevational view of the modified assembly;

Figure 12 is an enlarged plan view of the modified assembly;

10 Figure 13 is a schematic showing cords for moving carriers and a tilt rod;

Figure 14 is a somewhat schematic view of another modified carrier assembly;

15 Figure 15 is a view similar to Figure 14 of still another modified carrier assembly;

Figure 16 is a view similar to Figure 14 of a further modified carrier assembly;

Figure 17 is an fragmentation plan view on the line XVII-XVII the carrier assembly of Figure 16;

20 Figure 18 is a schematic perspective view of a further embodiment of window covering according to the invention;

Figure 19 is a top view of the covering of Figure 18 in the stretched state;

25 Figure 20 is a view similar to Figure 18 of a still further embodiment;

Figure 21 is a perspective view of a still further embodiment;

30 Figure 22 is an enlarged cross-sectional plan of the assembly of Figure 21;

Figure 23 is a schematic perspective view of a still further embodiment of window covering according to the invention;

35 Figure 24 is an enlarged cross-section showing the assembly of Figure 23;

Figure 25 is a schematic perspective view of a further embodiment of assembly according to the invention;



Figure 26 is an end elevation of the assembly of Figure 25;

Figure 27 is a view similar to Figure 26 of a slightly modified version; and

5 Figure 28 is a schematic perspective view of yet another embodiment of blind assembly according to the invention.

10 A fabric light control window covering (Figure 1) comprises first (front) and second (rear) parallel translucent or transparent fabric sides or faces 10, 12 and a plurality of opaque or semi-opaque vanes 14 extending between the fabric sides with the vanes being angularly controllable by relative movement of the fabric sides. The fabric sides are preferably sheer fabrics and will be so
15 referenced hereafter.

20 The window covering has a neat and uniform construction and outer appearance in all degrees of light control. The light control vanes are bonded to the sheer fabric utilizing linear application of a suitable adhesive along straight bond lines 16 and, thus, a high degree of controllability of the adhesive application process and bonding of the vane is obtained. The precisely uniform construction improves the operation of the covering by preventing warps or distortions from developing over its
25 life.

30 The covering operates with a high degree of repeatability, that is, always returns to the same appearance when closed. Thus, a feature of the present invention is attachment of the vanes to the sheer fabric sides such that the vanes tend to bias the window covering toward the minimum light admitting position. A further feature of the invention in this respect is a novel heat setting of the three layers together in order to provide a uniform and wrinkle-free shade at any temperature in
35 subsequent use. These features allow the window covering to maintain its original shape and appearance even in the presence of temperature extremes encountered in a window



environment.

Accordingly, a fabric light control shade (door or window covering) according to the present invention comprises a first sheer fabric sheet, a second sheer fabric sheet disposed parallel to the first sheet, and a plurality of relatively opaque fabric vanes adhesively bonded transversely between the sheet fabrics. Each vane has a edge portion bonded to the first sheet and an opposite edge portion bonded to the second sheet in a manner tending to bias the first and second sheets together. The window covering according to the present invention is adjustable between a closed position, minimum or no light entry, preferably no see through, and an open position, maximum light entry. The closed position is characterized by a central portion of the fabric strips being substantially parallel to the first and second sheer fabric sheets with the strips themselves being substantially planar; in this position, the front and rear sheets with vanes sandwiched therebetween are collapsed together. The open position is characterized by the central portion of the fabric strips being substantially perpendicular to the first and second fabric sheets and to the bonded edge portions of the strips themselves; in this position the front and rear sheets are spaced apart the maximum distance. Also, characteristic of this position is that portions of the strips between the bonded edge portions and central portions form smoothly curving surfaces which are free of creases or sharp folds. In an alternative embodiment, the central portions of the fabric strips are substantially flat and longitudinally extending hinge or flex points are provided parallel to the bonded edge portions. The covering is adjustable between the two positions by relatively shifting the front and rear sheets 10,12. This action moves them closer and closer together until they are collapsed together. In intermediate positions the light control is achieved.

When the window covering material is in a fully open, light admitting position, each vane has a central



portion which is substantially perpendicular to the first and second sheer fabrics. Edge portions of the vanes, which are bonded to the sheer fabrics, are connected to the central portion by transition portions having a smoothly curving shape. The adhesive bonding of the vanes allows formation without creases or sharp folds. The smoothly curved nature of these transition portions, in the fully open position, allows the vane to retain its resiliency and thus tends to bias the sheer fabrics into a closed or drawn together position. This ensures that the window covering does not lose its shape over time from repeated opening and closing. Furthermore, creases along the vanes can develop into failure points due to repeated bending inherent in the opening and closing of the window covering.

Moire effect must be avoided in the window covering. Although sheer woven fabrics having small interstices between the fibers provide a pleasant and desirable appearance for the first (front) and second (rear) sheer fabrics, when the same or very similar material of this type is used for the first and second sheer fabrics, a moire pattern is created by the fabrics when viewed in overlaying relationship due to light interference effects. This moire effect is eliminated in the present invention by providing for the first and second sheers woven and preferably knit fabrics of materials having differently sized, shape and/or oriented interstices. According to the present invention, the moire effect is also avoided by using a nonwoven sheer material as one or both of the first and second fabrics or by using a transparent plastic material as one or both of the first and second fabrics.

To avoid the undesirable moire effect when the first and second sheets of woven or knit material are viewed in overlying relation in the window covering of the present invention, the first and second sheers must have different appearances when the sheer panels are viewed along an axis perpendicular to the planes of the first and second sheer fabrics. The required difference in appearance between the



first sheer and the second sheer can be achieved in several different ways.

5 The first or front sheer 10 can be a woven or knit fabric having interstices of one shape and size and the second or rear sheer 12 can be a woven or knit material having interstices of a second shape and/or size and/or orientation. For example, the threads of the first sheer may run at an angle in range 30 to 60° relative to the vertical but in a preferred form run at an angle of 45° relative to vertical. The threads of the first sheer, for example, may run diagonally, forming diamonds, whereas the threads of the second sheer may run orthogonally forming squares. With this relationship between first and second sheers, the appearance of a moire pattern can be avoided. 10
15 Also, as described in more detail below, it is desirable that both sheer fabrics should have dimensional stability on the bias or diagonal.

 It is also possible to avoid the moire effect and provide the required difference in appearance by using a nonwoven sheer material, such as a plastic film material, for one of the sheers and a woven or knit material for the other of the sheers of the covering. Alternatively, nonwoven sheer materials, such as those formed from the same or different plastic fibres, can be used for both the first and second sheers. A translucent or transparent plastic film material can also be used as the first and/or second fabric. The use of a transparent material for at least one of the first and second fabrics also avoids the moire effect. 25

30 To achieve a suitable structure of the vanes, the vane material must have a certain degree of softness. As a general principle, the wider the vanes 14, the stiffer the vane material can be. However, since a broad range of vane widths may be employed in window coverings in accordance with the present invention, it is difficult to precisely 35
define an acceptable softness or stiffness range for the vane material.



A simple and effective physical test has been devised to determine whether a particular fabric is suitable for vanes having a specific vane width. The fabric being tested is allowed to hang over the edge of a table such that the distance from the edge of the fabric to the table top equals the desired vane width. If this width of fabric hangs substantially vertically, then it has sufficient softness for a vane of that vane width. For example, if a fabric is being tested for use as a 50mm wide vane, the edge of the fabric is extended 50mm beyond the edge of the table. If the extended 50mm of the fabric hangs substantially vertically from the table edge, it is suitable for use as a 50mm wide vane material. If the extended 50mm of the fabric does not hang substantially vertically, the fabric is too stiff to produce 50mm wide vanes having the gently curved appearance.

Stiffer fabrics, i.e., those which do not hang substantially vertically over a table edge at the length of the desired vane width, can also be used as the vane material. However, if a stiffer fabric is used for the vanes, longitudinally extending hinge or flex points must be provided along the edges of the vanes. The use of a stiffer fabric provided with hinge points produces a covering having a somewhat different appearance. In these circumstances, vanes have a straighter appearance and have a sharp bend at the hinge points, rather than a gently curving portion. The hinge points may be provided by score-compressing a stiff vane material, parallel to the longitudinal edges of the vane material. The score-compressed lines formed in the stiff vane material are spaced apart from the longitudinal edge of the vane material a distance sufficient to allow adhesive lines to be applied to the vane material between the longitudinal edge of the vane material and the score-compressed line.

A structure of the above type can also be produced using a soft vane material as previously described. In this embodiment, a stiffening agent is printed on the vane



material in the central portion thereof to provide flatter vanes. The longitudinal edges of the vane material are left free of stiffening agent and the required hinge points are formed at the longitudinally extending edges of the printed
5 on stiffening agent. The adhesive lines are applied to the longitudinal edges of the vane material, which longitudinal edges have been left free of stiffening agent.

According to another embodiment of the present invention, the vanes are formed of a black-out laminate
10 material to maximize the room darkening effect of the window covering when the vanes are oriented in the closed position. A suitable black-out laminate material is a three play laminate comprising a polyester film such as MYLAR sandwiched between two layers of a spun bonded or spun laced
15 polyester nonwoven material. Such a three play laminate has, by virtue of its construction, a greater stiffness than most single ply materials. Accordingly, score-compressed hinge points could be provided in the black-out laminate vane material if necessary.

20 Alternatively, to produce a covering of the present invention having a maximized room darkening effect, only a stiffened central portion of the vanes is formed from a black-out laminate material. The longitudinal edges of the vanes are left free of the black-out laminate to provide
25 the required hinge points and flexibility along the edges of the vanes. When the black-out laminate is provided only on the central portion of the vanes, it is desirable to space the vanes closer together than described above in order to ensure that the black-out laminated central portions overlap
30 when the covering is closed, for maximum room darkening effect. For example, for a 63.5mm wide vane with a 38mm wide black-out laminated central portion, the overlap of the vanes is preferable about 13mm.

35 Another possible vane material is vinyl or a laminate of a nonwoven material and a vinyl material. Generally, vinyl materials and laminates of nonwoven material and a vinyl material provide an increased room



darkening effect but are soft enough that score-compressed hinge points are not required. Of course, score-compressed hinge points could be provided if necessary.

As discussed with respect to the first and second sheers of the covering, when two woven fabrics are viewed in an overlaying relationship, an interference pattern or moire effect can result. When a nonwoven fabric is used for the vane material, the problem of a moire effect in the covering when it is closed is avoided. In some instances, however, it may be desirable to use a woven or knit material for the vane material. A basic woven material will give a moire effect because this type of material has a very ordered orthogonal surface structure. To avoid a moire effect when the covering, having a woven or knit vane material, is in the closed position, a crepe woven materials can be used as the vane material because crepe woven materials have a much more randomly oriented surface structure. Alternatively, the surface of the woven or knit material can be altered to randomize the surface fibers, for example, by sanding, napping or calenderizing.

Coverings having first and second sheer fabrics and vanes of various colours, and combinations of colours are contemplated within the scope of the present invention. For example, to provide a more transparent covering in the open position, dark sheer material can be used for the first and second sheers because dark colours reflect less light than lighter colours. Similarly, white or light coloured sheer materials provide a more translucent effect when the covering is open.

The vanes may be the same colour or a different colour than the first and second sheer fabrics. A problem of glue line show-through has been experienced, however, when the vane material is a dark colour and the first and second sheer fabrics are of a considerably lighter colour or white. To overcome the problem of a dark glue line showing through a light coloured sheer material when the vane is adhesively bonded to the first and second sheer fabric of



the covering, a small amount of whitener, about 0.5 to 1.0% by weight, is added to the adhesive before it is applied to the vane material. A particularly suitable whitener is titanium dioxide. The addition of this whitening pigment to the adhesive eliminates the problem of dark coloured glue lines being visible in a covering wherein a dark coloured vane is adhesively bonded to a lighter coloured sheer fabric. Also, the addition of titanium dioxide to the glue can be a way to dull the glue lines.

With respect to the vanes, it has been unexpectedly found that by increasing the machine-direction or lengthwise tension on the material prior to and during application of a binder composition, the machine-direction stiffness of the treated fabric is advantageously and significantly increased with a slight decrease in cross-direction stiffness of the treated fabric. The strips used for the vanes are cut from the treated fabric. A high ratio of machine-direction stiffness to cross-direction stiffness is desirable in the treated fabric, particularly when the treated fabric is to be fabricated into vanes. Depending upon the type and number of yarns in the woven textile material, the ratio of machine-direction stiffness to cross-direction stiffness for treated fabric according to this invention can range from between about 3:1 to 50:1, or more.

Increasing the machine-direction tension on the woven material while allowing neck down or letting the fabric go slack in the cross-direction causes the warp yarn filaments to draw in tightly and then the applied binder composition bonds these warp yarn filaments together such that the bonded filaments act as one much stiffer yarn. The lack of tension in the cross-direction allows the fill direction filaments to remain fluffy and, therefore, to not bond as easily to one another when the binder composition is applied.

In this process of treating the woven textile material to produce the treated fabric for the vanes, the fabric is treated with a low percentage (up to about 5%) by



weight solids add on of a binder composition. The preferred binder composition is applied to the woven textile material in an amount of about 2% by weight solids add on.

5 The binder composition with which the woven textile material is treated can be any suitable composition capable of filling the interstices in the woven textile material to bind the individual fibers. Examples of suitable types of binder compositions include elastomers which are capable of binding the individual fibers of the
10 woven textile material and which are resistant to ultraviolet (UV) radiation and to breakdown or degradation due to other environmental factors. Especially preferred compositions are elastomeric acrylics and elastomeric urethane-type compositions.

15 The maximum spacing of the front and rear sheers is dependent on the vane width. According to the invention vane widths of 50 to 150mm before assembly are used but 63.5 to 100mm widths are preferred. In the best mode for carrying out the invention the maximum spacing between the
20 front and rear fabrics is 67mm using vanes 89mm wide with 76mm spacing between successive vanes to achieve an appropriate vane overlap.

It is also desirable for both sheer fabrics 10 and 12 to have dimensional stability generally in the bias or
25 diagonal lines as indicated by the arrows A and B in Figure 1. The reason for this is as follows.

In a window covering of this nature, the covering is opened and closed by moving the front and rear sheer fabrics 10 and 12 horizontally relative to each other,
30 conveniently by forces which are applied to the top edges of the respective sheers by actuators, or the like yet to be described. When the covering is being closed, the sheers are moved in the horizontal directions indicated by arrows C and D. During this operation, to provide effective closure
35 of the vane over the entire height of the covering the front sheer 10 should be dimensionally stable diagonally, i.e., in the direction of arrows A, and the back sheer 12 should also



be dimensionally stable in the direction of arrows B. Conversely, when the covering is being opened and the sheers are moved horizontally in directions opposite arrows C and D, in order to ensure uniform turning of the vanes from top to bottom the front sheer 10 should be dimensionally stable in the direction of arrows B and the back sheer 12 should be dimensionally stable in the direction of arrows A.

The diagonal stability referenced above can be obtained from knitted fabrics and such fabrics are preferable for use in the present invention. Knitted fabrics can be formed in numerous configurations including those where the knitted yarns run diagonally of the fabric and thus promote the desired stability. Commercially available knitted patterns are illustrated in Figures 1a and 1b and either would be suitable for use in the present invention. By utilizing the knitted patterns of Figure 1a for the front or the back sheer and the knitted pattern of Figure 1b for the other sheer, the undesirable moire effect can be avoided.

This can be best achieved by having the front sheer 10, i.e., that facing the interior of the room, formed of a knit material such as that illustrated in Figure 1b. This is a tulle-type fabric made on a warp knitter which is characterized by diamond-shaped interstices 27. The diamond shapes effectively counter diagonal forces as well as help to cancel out moire patterns in conjunction with the more orthogonal structure of the rear sheer.

The rear sheer 12, which generally faces the window or outdoors, is best formed of a knit material such as that illustrated in Figure 1a. This type of fabric is also made on a warp knitter. It will be seen that such a fabric, as viewed under the microscope, has a plurality of generally parallel bundles of yarn. These bundles are joined by a plurality of generally transverse extending very fine yarns 15, 17, 19, 21. These yarns extend diagonally upward and to the right at slightly different angles to the horizontal on one side of each bundle 1 and extend



downwardly and to the left, again at these different angles to the other side of the bundles.

The above-described fabric structure produces diagonal dimensional stability to the fabric in the direction of the arrows A and B in Figure 1 and yet provides considerable lateral softness and longitudinal strength.

The fabric light control window or door covering is to be supported from carriage assemblies 20 (Figure 2) that have freely rotatably mounted wheels 22 that ride on tracks 24 defined by a conventional drapery track generally designated as 26. The main body 28 of the carriage is a plastic molded body in which is held a bearing for a gear 30, easily pushed into the body, and is in meshing engagement with a worm 32 journaled in body 28 and operated by a splined tilt rod 34 which extends through the worms of all the carriers. Rotation of rod 34 via a wand, cord 35 (Figure 13), or the like drives worm 32 causing worm gear 30 to rotate. Optionally, a stop may be included to confine worm gear 30 to less than 360° rotation. All of the above is conventional and may be seen, e.g., in US-A-4648436, which disclosure is here incorporated by reference. Spacers, not shown, are mounted to assemblies 20 in a conventional manner via a slot in body 28 and to a cord 29, spindle or the like in a conventional manner to effect the conventional drawing action to spread out the carriage assemblies 20 along the track or to gather them at one end. Alternatively, a conventional scissors arrangement can be used to replace the spacers. Furthermore, the spacer or scissors arrangement may be omitted so that the front and rear fabric define the distance between carriers when the light control covering is in its expanded condition.

A threaded shaft 40 is fixed to worm gear 30 and extends below or depends from the main body 28 via bearing projection 31 and has an L shaped actuator control element 42 fixed thereon by a nut 43 holding the horizontal leg of element 42 fixed to shaft 40. Shaft 40 extends further downwardly passing freely through an actuator arm 44 and has



a pair of nuts 46 threaded onto its lower end to lock and establish a stop and provide height adjustment.

Arm 44 extends for a distance at least equal to the maximum opening of the covering, e.g., 67mm and at either end is connected with a hanger or an attachment member 50 consisting of a paddle like lower end having a hole 52 adjacent its lower free end and an upper end that is freely pivotally mounted in the end of arm 44 by any conventional mounting means. A spring 58 is fixed at one end to the arm 44, such as by passing through hole 54 in arm 44 and being bent or crimped. The other end of spring 58 is fixed to the depending leg of actuator element 42 in a like manner. When splined tilt rod 34 is actuated and drives worm 32, worm gear 30 via element 42 and spring 58 will cause arm 44 to rotate around shaft 40.

Hanger 50 may consist of a body 70 in the form of a T with a pair of deflectable spaced headed or barbed connectors 72 extending upwardly from the top of the cross bar of the T for insertion into the hole at the end of arm 44 as shown in Figure 3. A hole at the lower end of the depending leg of the T cooperates with a pin 73 having a pair of spaced deflectable barbed heads. As shown in Figure 5, the light control covering is mounted on the arm 44 by attaching one hanger 50 to the front sheer, on its inside face precisely at the glue joint formed between a vane and the front sheer. The other hanger 50, at the other end of arm 44 is attached to the inside face of the rear sheer at a point displaced from the glue joint for the same vane in the direction toward the front sheer attachment for that vane. The top inside edge of the front and rear sheers can be provided with a reinforcing strip 74 so pin 72 can clamp the top edge of the sheers to hangers as shown in Figure 3.

The light control covering is mounted over a window with its vanes extending vertically. Actuator arms 44 of the respective carriers 20 are preferably attached to the covering for every other vane as shown in Figure 5, which shows the covering fully extended over a window or



other opening and in the open position (maximum light passage). Alternatively the carrier may be provided at every third or fourth vane. To move the covering to the closed position as shown in Figure 6, the tilt rod is
5 rotated, driving each worm 32, worm gear 30, shaft 40 and rotating each actuator 42 which in turn, through spring 58, carries arm 44 around shaft 40 bringing the covering to its closed position. At this time, since there is little
10 resistance to rotation of arm 44, spring 58 is not substantially extended or loaded. This condition continues as the covering approaches the closed condition shown in Figure 6 and proceeds through the closed condition to an over-closed position shown in Figure 9. The net effect will be slight overtravel of the closed position with the panels
15 (a vane sandwiched between front and rear sheers) now slightly tilted out of the plane of the normally closed plane. Then the resistance to further rotation of the arms 44 caused by the fabric layers having closed on one another becomes greater than the force of the springs 58. Thus,
20 continued rotation of actuators 42 extends and tensions the springs until the actuators 42 engage arm 44 as shown in Figure 7.

When the extension of the covering in the over-closed position (full extension of carriers 20) is relieved,
25 as the covering is drawn to the retracted position (gathering of carriers 20 at one end) and retracted from covering the window successively, the pressure on arms 44 exerted by the extended fabric is released and the springs 58 will draw the arms 44 around to the substantially
30 parallel positions shown in Figure 8 and cause successive panels to collapse and fold upon themselves in substantially parallel folds.

Where the fabric itself or spacers define the distance between adjacent carriers when the light control
35 window covering is in its expanded condition, the carriers are not all moved at the same time to the retracted position of the light control window covering. A first carrier is



moved towards an adjacent second carrier by means of a cord, spindle or the like. When the first and second carriers abut, the first carrier moves the second carrier towards the next carrier adjacent to the second carrier, and so on. The panels of the already abutting carriers will be folded upon themselves whereby the remaining panels will still be in the slightly overclosed position. Consequently, the panels are successively collapsed and fold upon themselves.

Where a scissor arrangement is used, all carriers are moved to the retracted or stacked position at the same time. Again, the movement is initiated by a cord, spindle or the like which acts on a first carrier whereby the scissor arrangement will cause the other carriers to move upon movement of the first carrier. Consequently, all of the panels will gradually collapse and fold upon themselves at the same time.

The springs 58 store rotational energy in the actuator arms 44 when the sheers have been closed upon themselves and release the stored energy when the covering is retracted across the window opening causing the panels to fold neatly on themselves with the actuator arms 44 all parallel and perpendicular to the track rail 26.

In a preferred embodiment, the actuator arms are 74.6mm long and the hangers for holding the top edges of the front and rear sheers are 76.2mm wide outside-to-outside or approximately equal to the vane spacing of 76.2mm for 88.9mm vanes. Because of the S shape or curving of the vanes and because the hangers are not parallel to the vanes, the maximum spacing of the front and rear sheers is, by way of example, 66.7mm. Most of the components noted in the above description are injection molded plastic parts. The front fabric may be polyester of about 23.7gm/m² (from about 4.7-47.5gm/m²) and is a tulle knit with a diamond pattern.

The rear fabric may also be polyester of the same weight and is a warp knit with diagonal threads and has an orthogonal pattern. The principal characteristic of the rear fabric is the necessity for stability on the bias or



diagonal. The vanes are a woven polyester of a weight of 47.5gm/m² (about 24-95gm/m²) weight. The vanes are preferably opaque but may be translucent for privacy. A stiffener tape is attached to the inside top edges of the front and rear fabrics to enable reinforcement to be able to hang the fabrics on the hangers depending from the actuator arms. Grommets could be used for this purpose, if desired. Weights (about 15gm weight) are attached to the bottom edge portions on the inside of every other vane at its front and rear portions directly below the attachment points to the hangers, one 15gm weight per specified location.

The tilt rod can be operated by a wand or by one or two pull cords as already known in the art, see Figure 13. Also, the carriers or carriages may be associated with spacers which can be metal strips that fit through slots in the carriers and have stops at each end so the lead carrier can be traversed on the track by a cord arrangement and successively draw out the rest of carriers in appropriate spacing. When retracting the carriers, the lead carrier is drawn back and the strips slip through their slots to allow the carriers to stack at one end. Alternatively a scissors spacer can be used. Both are known and are coupled to the carriers in a known way. When moving the carriers from the retracted or stacked condition of the vanes, the opposite situation arises and the assembly will move firstly from the position of Figure 8 to that of Figure 7 and then to that of Figure 6. Thereafter, if one chooses, one can continue to operate the vanes so that they finish up more or less in the position of Figure 5.

The carriers can be provided with a coupling arrangement between the drive shaft and the actuator to effect over-closing and a tilt toward collapse with a slight force favouring collapse upon relief, or an arrangement as shown in Figures 10-12 whereby a return force is imposed on the actuator arm 44', such as, by a weight or cam member 80 riding on top of the worm gear 30' and cooperating or coupling therewith via interfitting inclined camming



surfaces 90. In this arrangement where like references are used to denote like parts to those in the previous embodiment, the weight 80 is keyed to the shaft 40' which carries actuator arm 44' by keys 84. The worm gear 30' is
5 freely rotatable about shaft 40' and is retained in the carrier body 28' by a snap ring 86 or the like. When the actuator encounters little resistance in moving from the open position shown in Figure 5 to the closed position shown in Figure 6, the worm gear drives the actuator through the
10 coupling formed by the interfitting inclined surfaces 90 on the gear 30' and weight 80. Resistance resulting from over-closing, however, will cause the worm gear to drive the weight up the incline out of coupling engagement with gear 30' and store energy in the weight for driving the actuator
15 when the resistance is relieved by the weight dropping back into register with the inclined surface on the worm gear.

With an arrangement of the type shown in Figures 10 to 12, retraction of the light control window covering can be stopped (i.e., in an intermediate position) when some
20 but not all of the panels are collapsed and folded over upon themselves. The non-collapsed panels, which are still in the slightly over-closed condition, can then be used to regulate the light through the panels as previously described whereby the already collapsed panels remain in the
25 collapsed position. A feature of the arrangement of Figures 10 and 12 is that the actuator 44' will be lifted during overtilting.

In a further modified carrier assembly as shown in Figure 14, where again like references are used to denote
30 like parts, the actuator 44'' is carried by a shaft 40'' depending from a rotary cam 92 in the carrier body 28'' which in this case has a closed top 94. The worm gear 30'' is mounted above the cam for rotation about a shaft 96 and the worm gear and cam have interfitting inclined camming
35 surfaces 90''. A coil spring 98 may be provided to exert downward pressure on the worm gear.

In this arrangement, when the covering is being



closed and there is little resistance to movement of the actuator, the cam and actuator are rotated by the worm gear through the interfitting surfaces 90''. When excessive resistance is encountered, as previously, the worm gear will
5 be lifted against the pressure of spring 98, for energy storage. When the resistance is reduced, the spring pushes the worm down back into engagement with the cam, thereby rotating the cam and actuator. Alternatively, the worm gear itself may comprise a weight for energy storage and the
10 spring can be omitted.

Contrary to the arrangement of Figures 10 to 12, the arrangement of Figure 14 does not lift the actuator during overtilting. The interfitting inclined cam surface can be so shaped that the holders are naturally returned to
15 a fixed home centre position. This arrangement is particularly helpful when one is using a single control or so called "mono-command" arrangement which provides both movement of the carriers and tilting of the vanes. The reason for this is that with this "mono-command" system,
20 when one operates the control with a view to moving the carriers in the opposite direction from previously, the first thing that happens when the panels are in the collapsed position (light control window covering being retracted) is that the vanes are starting to tilt in the
25 direction in which the window covering would give maximum light passage when it is in its fully expanded condition. However, because the vanes are still in their collapsed position and cannot fully tilt towards said maximum light passage condition, the actuators will be loaded in a
30 direction opposite to the direction in which the actuators are loaded when the window covering is in its overclosed position. Once the actuators are all loaded, the end carrier begins to move, thereby allowing subsequent vanes to tilt to their maximum light passage condition whereby the
35 actuators will be unloaded. Hence, when the window covering is moved to its expanded condition the vanes reach the maximum light passage condition. Once the window covering



has reached its fully expanded condition the window covering can be closed by operating the mono-command arrangement in an opposite direction. The vanes will close and will all substantially lie in one plane as previously described.

5 Upon further operation of the mono-command system the vanes will overclose and the actuator will be loaded as described earlier. Upon again further operation of the mono-command system the end carrier starts to move towards the collapsed condition of the window covering and the panels will fold in
10 a zigzag way whereby the actuators will become unloaded. The actuators must therefore be capable of loading in either direction so as to enable this operation to take place in either one direction or the other. In a still further modified carrier assembly as shown in Figure 15, the
15 actuator 44''' is carried on a shaft 40''' rotatably mounted in carrier body 28''' and having a cam 92''' at the top of the shaft. The worm gear 30''' is rotatably mounted about the shaft and interfitting V-shaped camming surfaces 90''' are again provided on the worm gear and cam. The worm gear
20 sits on a coil spring 98''' at the base of body 28'''. In this arrangement, when the resistance to rotation of the actuator becomes excessive, the worm gear is cammed downwardly against the bias of the spring 98''' by cam 92''' and when the resistance is decreased the worm gear is sprung
25 back up to re-engage the surfaces 90''' and rotate the actuator 44'''.

The system for operating the opening and closing of the window covering and the system for tilting the hangers may be separated (individual operation) or may be
30 combined in a mono-command system (combined operation), which systems are well known in the art. In the latter case, it will be possible to move the carriers and tilt the hangers by operation of one simple wand, cord or the like. Furthermore, the above operation may be actuated by motor
35 drive means which are operable by means of, for example, a remote control unit.

Experience has shown that there can be a problem



that the bottom of the end portion of the window covering tends to move towards the centre of the window covering, that is the end edges tend to be not truly vertical, but angled slightly inwardly of the vertical from top to bottom.

5 According to the invention, this may be overcome by providing a facility on the carriers at the ends of the window covering for lifting only the end actuator arms. In fact the problem comes even more acute when the window covering is moved to the position in which the vanes are
10 open, i.e. substantially perpendicular to the sheer fabrics. The invention therefore further provides a facility by further lifting of the actuator arm as the window covering is turned to the open position. One or two carriers according to the construction of Figures 10 to 12 may be
15 used at an end location to produce this lifting effect.

Another structure of carriage suitable for carrying this out is illustrated in Figure 16 in which like parts have been indicated by like reference numerals to those of Figure 10, but with the addition of the reference
20 letter A. In this structure the worm gear 30A is again urged downwardly by a spring 98A and is provided with a lower cam surface 80A provided with opposite flat portion 80B. A cam member 90A is fixedly secured to the housing 28A of the carrier and has cam surfaces 81A and 81B
25 complementary to surfaces 80A and 80B respectively. Cam member 90 is of annular form allowing for the passage of the downwardly extending threaded shaft 40A fixedly secured to the worm gear 30A. The actuator arm 44A is provided with a central bearing sleeve 82, preferably of metal, which is
30 freely rotatable about the threaded shaft 40A.

Threaded onto the shaft 40A is a locking ring 83, the lower surface of which bears against the upper surface of the bearing sleeve 82. This sleeve is provided with an upwardly extending projection 82A which is capable of being
35 engaged in one of a plurality of circumferentially spaced indentations 83A in the lower surface of the ring 83. (See Figure 17).



Located below the bearing ring 82 is a wing nut 85 which can be screwed up to bear against the lower surface of the ring 82.

5 Mounted above the wing nut 83 is a spring holding plate 87 having an aperture therein for the passage of the shaft 40A, the latter having a key way 40B engaged by a key 87A on the plate 87. In this way the plate 87 is caused to rotate with the shaft 40A. A spring 58A is connected to the plate 87 as shown and also to the arm 44A.

10 In order to initially adjust the height of the arm 44A the wing nut 85 is loosened downwardly which enables the locking ring 83 to be rotated. In this way, if it is rotated upwardly, then when the wing nut is again tightened, the arm will be raised to a higher level. By use of a wing
15 nut and a knurled locking ring 83, this operation can be carried out readily by the installer.

When the vanes carried by the arm 44A are turned to a direction perpendicular to the sheer fabrics, the cam surfaces 80A and 81A will ride up one another to give a
20 further raising of the arm 44A. The fully opened position will be determined by the flats 80B and 81B engaging one another. If necessary, a suitable ridge and groove can be provided in these flats to determine accurately the perpendicular position of the vanes. When the blind is
25 moved back to the closed position of the vanes, the cams will be such as to allow the worm gear 30A to fall again, thereby lowering the arm 44A, progressively as the vanes move to the closed position. The spring 58A will operate as previously.

30 However, it will be noted that because there is no equivalent to the down turned portion of the element 42 of Figure 2, the arm 44A can move equally in either rotational sense and the provision of a plate 87 keyed to the shaft 40A, the spring 58A will provide a fixed home centre
35 position for the arm 44A and thus of the associated vane.

An alternative to the spring 58A and plate 87 would be a C shaped spring having its centre portion secured



to the shaft 40, 40A and its side arms engaging one on each side of the arm 44, 44A. This again will provide for a fixed home centre position.

5 In one structure according to the invention, instead of providing for the end vane of any of the blinds described above to be capable of being turned, provision can be made for each end vane always to be fixed in the "open" position, i.e. perpendicular to the sheer fabrics. This can assist in ensuring that the window covering stacks neatly as
10 shown in Figure 8, as the covering is drawn back to the fully open position. It is particularly useful when the covering for a window comprises two parts, one which is stacked to the left of a window and the other to the right, as with conventional curtains or drapes.

15 It is also contemplated that, as an alternative, vanes could be controlled so that they remain closed as the window covering is expanded towards the closed window covering position.

As illustrated in Figure 20, to be described
20 later, the hangers may be coupled directly to the vanes. In this case, the vanes, which are directly tilted by the hangers, should be sufficiently stiff to operate the window covering from its open towards its closed and collapsed condition.

25 Referring now to Figures 18 and 19, there is again shown a window covering formed in the same manner with two sheer fabrics 10,12 and vanes 14. Secured to the sheer fabric 10 at one end thereof is a first end rail 102 and secured to the other end of the second sheer fabric 12 is a
30 second end rail 103.

Extending above the window covering is a horizontal track 122. The first end rail 102 is mounted on a bracket 158 having a first arm 156 associated with two sliding carriers 152,154 slidable in the track 122 and a
35 second arm 160 engaged in end rail 102. The lower end of the head rail 102 is shown as not riding in a track but it is conceived that it could ride in a lower track similar to



upper track 122.

Some, but not all, of the vanes 14 are provided with runners 162. In the construction shown every third vane 14 is provided with a runner 162. This may be in the form of a plastics material plate having an upwardly extending pin with a head on it, which rides in the track 122.

The second end rail 103 is preferably fixed, e.g. as at 145 to the floor.

It will be appreciated that if one grasps the first end rail 102 and moves it to the left, then the covering will concertina up in the manner indicated and will draw back in the manner similar to that of a curtain. If one pulls the end rail 102 to the right then it will stretch out so that the window covering is as shown in Figure 19. Further movement of the end rail 102 and the bias of the vanes will cause deflection of the vanes 14 to provide more or less passage for light through the covering.

If reference is now made to Figure 20, there is shown a headrail 240 in which are mounted a plurality of sliding carriers 242 which are preferably provided with wheels (not shown) for running along guide tracks formed in the headrail. Movement of the carriers 242 can be effected in any suitable manner but as shown a cord system 246 is provided. The assembly of carriers in the headrail may be generally similar to that disclosed in US Patent 3996988 in the name Dwight or in US Patent 4267875, in the name Koks. As in the Koks patent, a tilt rod may be provided and this may be rotated by a pulley with a bead chain 250. The tilt rod is associated with a worm and worm wheel, as in Koks US Patent 4267875, and the worm wheel in each carrier is connected to a separate hanger 252. Supported by the hangers is a window covering 210 comprising front and rear sheer fabrics 270, 272 between which extend vanes 274, which are connected to the fabrics 270, 272 in any suitable way e.g. by adhesive. The upper ends of the vanes 274 are mounted on the hangers 252. It will be appreciated that the



operation of the vanes can be effected by operation of the bead chain 250 rotating the pulley which in turn rotates the tilt rod. Rotation of this tilt rod will effect rotation of a worm wheel and pinion (not shown) which will in turn cause the hangers 252 to rotate about their respective vertical axes. This rotation will, it will be appreciated, cause tilting of the vanes 274 about their respective vertical axes.

If one operates the pull cord 246 then the end one 43 of the carriers will be pulled to the left or the right. Since these carriers have associated with them spacers 275, movement to the right of the end carrier 243 will cause the adjacent carrier 242 to move to the right with it and then the subsequent carriers will also in turn move to the right to provide the right spacing.

It will be appreciated that when the end carrier 243 is moved to the right, this will have the effect of moving the vane associated therewith. After a certain distance of movement, the sheer fabrics themselves will cause the next vane, and its carrier, to move to the right also and so on.

It is also further contemplated that the structure shown in Figure 20 could be modified so that there is no facility for moving the carriers 242 along the end rail. Thus, these carriers could be fixed so that the window covering is always in the position as illustrated in Figure 20 and the only facility for adjustment, therefore, will be adjustment of the angle of the vanes.

In Figure 21 sheer fabrics 312,314 are connected to circumferentially spaced apart fixing means 320,322 on a wind up roll 324 which is mounted with its longitudinal axis extending generally vertically to one side of the frame of a window. The lower end of the roll can be fixed to the floor or to a location below the window. Vanes 316 extend between fabrics 312 and 314.

Associated with the roll 324, at the upper end thereof, is a cord reel 326 and a control pulley 330 at the



end adjacent the reel 326. Rotation of the wind up roll 324 can be effected by operation of a cord, for example a bead cord 332 wrapped around the control pulley 330.

Alternatively a motor drive could be provided. This
5 rotation is also imparted to the cord reel 326.

Wrapped around the cord reel 326 is a tension cord 334 which also passes around a fixed pulley 338 and is connected to the upper end of an end rail 342 having, in its interior, a tension spring 344 to the upper end of which is
10 attached the end of the tension cord 334. As can be seen more clearly in Figure 22, the end rail 342 is attached to the second sheer fabric 314 only.

Extending generally horizontally above the window covering 310 is a horizontal track 350 in which are
15 horizontally movable two sliding carriers 352, 354 which are attached to one arm 356 of the right angled bracket 358 having a second, lower arm 360 secured to the end rail 342 so that the latter can hang downwardly and be supported by the sliding carriers 352, 354 in the track 350. The lower
20 end of the end rail 342 is not secured although it could be guided in a further track at the bottom.

In operation initial movement of the wind up roll 324 will effect the change of the relative angles of the vanes 316 to the sheer fabrics 312, 314 and further movement
25 will cause the covering 310 to wind up on the roll 324. As it is rolled up, the sliding carriers 352, 354 will slide along the track 350 carrying the end rail 342 with them.

If the roll 324 is operated in the opposite sense, then the end rail 342 will be pulled back by the tension
30 cord 334.

In Figure 23 there is illustrated a form of window covering suitable for covering a skylight in a horizontal or inclined roof.

The assembly includes a flexible window covering
35 indicated by the general reference numeral 410 this including the first sheer fabric 412, a second sheer fabric 414 and a plurality of transversely extending vanes 416



extending therebetween, the vanes being generally parallel to one another. This window covering 410 can be made in a number of different ways which do not form part of the present invention. The sheer fabrics 412,414 are made of a translucent or transparent material such as paper, a woven fabric or non-woven fabric or indeed they can be made of a plastics material. Similarly the vanes 416 can be made of any suitable material. However, they are preferably formed of a opaque or semi-opaque material.

The sheer fabrics 412,414 are connected to circumferentially spaced apart fixing means 420,422 on a wind up roll 424 which is mounted with its longitudinal axis extending generally horizontally to one side of the frame of a skylight.

Associated with the roll 424, at each end thereof, are cord reels 426,428 and a control pulley 430 at the end adjacent the reel 426. Rotation of the wind up roll 424 can be effected by operation of a cord, for example a bead cord 432 wrapped around the control pulley 430. Alternatively a motor drive could be provided. This rotation is also imparted to the cord reels 426,428.

Wrapped around the cord reels 426,428 are tension cords 434,436 which also pass around fixed pulleys 438,440 and are connected to opposite ends of an end rail 442 having, in its interior, a tension spring 444 to the ends of which are attached the ends of the tension cords 434,436. As can be seen more clearly in Figure 24, the end rail 442 is attached to the second sheer fabric 414 only. Two parallel tracks 443 are provided, one on each side of the covering, the tracks extending generally perpendicular to the axes of the wind up roll 424 and the end rail 442, the tracks for example being of channel or L-cross-section. At each end of the rail 442 a runner 445 is mounted and is slidable longitudinally in the adjacent track 443 and serves to guide and support the rail. If desired further runners (not shown) could be provided on some of the vanes 416, these also sliding in the tracks. It is also contemplated that



the tracks 443 and runners 445 could be omitted, particularly on smaller installations.

It will be understood that initial operation of the bead cord 432 will cause a certain rotation of the wind up roll 424. This will cause relative movement of the two sheer fabrics 412,414 with respect to one another in a direction parallel to one another. Thus the vanes will be caused to move from a position in which they extend in spaced apart relation, somewhat as shown in Figure 24, in which light can readily pass therethrough, to a closed position in which they overlap each other thus blocking off the passage of light.

Further movement of the wind up 424 will cause both of the sheer fabrics 412,414, with the flattened and overlapping vanes 416 therebetween, to be wound up onto the roll 424. As this happens, the end rail 442 will move towards the wind up roll 424 so that the window covering can be pulled back by a desired distance and in fact can be pulled back completely.

If the bead chain 432 is operated in the opposite sense, then the cord reels will rotate in the opposite direction as will the wind up reel 424. The tension cords 434,436 will then tend to pull the end rail 442 back to the right as shown in Figure 23, thereby drawing the window covering to cover the window.

In Figure 25 there is illustrated a further form of window blind assembly indicated by the general reference numeral 510. This assembly 510 is associated with a headrail 512 provided with an elongate tilt roll member 514 means (not shown) being provided to rotate this roll about its generally horizontal axis.

The material 510 includes a front sheer fabric 516 provided with a plurality of spaced parallel, horizontal forward pleats 518 and rearward pleats 520. The material 510 also includes a rear elongate sheer fabric 522 formed with forward pleats 524 and rearward pleats 526 similar to the pleats 518,520 of the front elongate sheer fabric 516.



As best seen in Figure 26 a plurality of vanes 528 interconnect the front and rear sheer fabrics 516,522. The vanes 528 in Figure 26 extend between a rear, interior, face of a rearwardly extending pleat 520 of the front sheer fabric 516 diagonally upwardly to where it is connected to the forward interior face of a forwardly extending pleat 524 of the rear sheer fabric 522.

As shown the front and rear sheer fabrics 516,522 are connected to a bottom rail 530 adjacent their lower ends and are connected to the elongate tilt roll 514 at their upper ends. In the construction illustrated a spacer member 532 is provided below the headrail and is connected to the front and rear sheer fabrics adjacent further pleats 518,526 thereof. This spacer 532 is not essential but provides a better configuration for the upper parts of the pleated blind material.

Figure 27 shows a slightly modified structure in which like parts have been indicated by like reference numerals. The vanes are here indicated by the reference numeral 534 and are connected slightly differently. In this construction the lower parts of the vanes 534 are connected to the rear, interior, face of a forwardly extending pleat 518 of the front sheer fabric 516 and the vanes are again inclined diagonally upwardly and connected to the front, interior, face of a forwardly extending pleat 524 of the rear sheer fabric 522. In this construction the vanes 534 are not planar as in Figure 25 but are reversed curved as shown at 536 and 538.

It will be appreciated that such a structure is, in some ways, rather similar to a venetian blind with the vanes 528,534. It will be appreciated that if the tilt roll 514, in either structure, is rotated in a clockwise sense, as seen in Figure 26 or Figure 27, the vanes 528,534, will overlies one another because they are in an overlapping mode and will thus, effectively, block the passage of light. If, however, the tilt roll 514 are tilted in a counter-clockwise sense, then the vanes 528,534, can be moved to a position in





which they extend substantially horizontally, while remaining parallel to one another, so that there can be a passage of light therebetween.

For this purpose, therefore, the sheer fabrics
5 516,522, need to be formed of a translucent or transparent material, such as paper, or woven fabric, or non-woven fabric, or indeed they can be made of a plastics material. Similarly, the vanes 528,534 can be made of any suitable material. However, they are preferably formed of an opaque
10 or semi-opaque material.

The vanes are connected in a suitable manner to the respective pleats 518,520,524,526 as appropriate. While it is contemplated that this could be done by a heat technique, such as by welding, they are preferably adhered
15 by means of a third material such as stitching or stapling, but according to a preferred arrangement they are connected by being adhered, preferably using a hot melt adhesive, which melts at a temperature significantly below the melt temperature of the sheer fabric. It would be appreciated
20 that the sheer fabric needs to have the pleats set in it and this can be done by a heat setting process which should again be conducted at a temperature in excess of the temperature of melting of the hot melt adhesive.

If reference is now made to Figure 28, a further
25 rather different structure is illustrated. This structure has the pleats of the sheer fabrics extending generally vertically. In detail, therefore, the structure of Figure 28 employs a headrail 540 in which are mounted a plurality of sliding carriers 542 which are preferably provided with
30 wheels (not shown) for running along guide tracks 544 formed in the headrail. Movement of the carriers 542 can be effective in any suitable manner but as shown a cord system 546 is provided. The assembly of carriers in the headrail may be generally similar to that disclosed in US Patent
35 3996988 in the name Dwight or in US Patent 4267875, in the name Koks. As in the Koks patent, a tilt rod 547 is provided and this may be rotated by a pulley 548 with a bead

chain 550. The tilt rod 547 is associated with a worm and worm wheel, as in Koks US Patent 4267875, and the worm wheel in each carrier is connected to a separate hanger 552.

Now the blind material shown in Figure 28 is generally similar to the blind material shown in Figure 26 and like parts have been shown by like reference numerals. In this structure, however, the pleats 518, 520, 524, 526 extend vertically as do the vanes 528. The upper ends of the vanes are mounted on the hangers 552. It would be appreciated that the operation of the vanes can be effected by operation of the bead chain 550 rotating the pulley 548 which in turn rotates the tilt rod 547. Rotation of this tilt rod will effect rotation of the worm wheel and pinion (not shown) which will in turn cause the hangers 552 to rotate about their respective vertical axes. This rotation will, it will be appreciated, cause tilting of the vanes 528 about their respective vertical axes.

If one operates the pull cord 546 then the end one 543 of the carriers will be pulled to the left or the right. Since these carriers have associated with them spacers 554, movement to the right of the end carrier 543 will cause the adjacent carrier 542 to move to the right with it and then the subsequent carriers will also in turn move to the right to provide the right spacing.

As shown in this structure, a first end rail 560 is associated with the right hand end of the sheer fabrics, rather in the manner of the bottom rail 530 of Figures 26 and 27. This end rail can be mounted on its own hanger which would then be associated with the end carrier 543, or it can be mounted on the same carrier as the right hand most vane. This end rail will then move with the end carrier and will act as a positive end to the "curtain" formed by the blind assembly of the invention. A second end rail 564 may, if desired, be provided at the other end. However, neither of the end rails are absolutely essential with the structure.

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CLAIMS

1. A light control shade assembly comprising in combination:-

a) a shade member comprising:-

i) first and second generally parallel spaced apart, vertically extending, translucent sheets (10,12,270,272,312,314);

ii) a plurality of longitudinal, parallel spaced vertical vanes (14,274,316), fixedly secured with their opposite longitudinal edges to said first and second sheets to extend therebetween;

b) carrier means (20,162,242,352-360) connected to said shade member to suspend said shade member in an extended vertically planar condition in which said shade member is effective in shading a predetermined area and in which condition the vanes can be manipulated to alter their orientation between a closed position parallel to the first and second sheet and an open position generally perpendicular to said first and second sheet to obtain light control in the shaded area.

2. An assembly according to claim 1, wherein said carrier means comprise a guide track (26,122,240,350) and at least one carrier (20,158,162,242,352-360) guided by said track and movable therealong, said at least one carrier being connected to said shade member.

3. An assembly according to claim 1, wherein the carrier means comprise a plurality of carriers (20,162,242) each carrier including an actuator (44), said actuators being connected at spaced intervals to the upper edge portion of the shade member and wherein manipulation of said vanes is effected by tilting of said actuators (44).





4. An assembly according to claim 3, wherein each actuator comprises a pair of depending hangers attached to the respective sheets.

5. An assembly according to claim 4, wherein one of the depending hangers of a pair is connected at the location where a vane is fixedly secured to one of the sheets.

6. An assembly according to claim 5, wherein the other depending pivoting hanger of each actuator is connected to the other sheet at a location between two adjacent vanes.

7. An assembly according to claim 3, wherein the hangers are connected directly to the vanes.

8. An assembly according to claim 3, 4, 5 or 6, wherein each carrier comprises a rotary drive mechanism (30,32,40) for rotating said actuator (44) to rotate a respective vane and a rotary tilt drive means (34) associated with all of said drive mechanisms to rotate all of said actuators simultaneously.

9. An assembly according to claim 8 and further comprising a guide track for movably guiding said carriers and energy storing and release means (58,90,92) connected between the drive mechanism and the actuator (44) for storing energy in the actuator, when the actuator is arrested by encountering resistance created by said sheets in the closed position and releasing energy effective to provide additional rotation of the actuator when said resistance is relieved by movement of the carriers from a spread condition to a stacked condition so as to stack the covering in substantially parallel folds.

10. An assembly according to claim 9, wherein said energy storing and release means comprises a weight movable





in opposition to gravity.

11. An assembly according to claim 8, wherein said drive mechanism includes a shaft (40) depending from the carrier, drive means (30,32) on the carrier rotating the shaft and an actuator control element (42,87) mounted on said shaft for rotation therewith, said actuator member being rotatably mounted on said shaft and wherein said energy storing and releasing means comprises resilient tensioning means (58,58A) connected between the actuator control element (42) and the actuator (44).

12. An assembly according to claim 11, wherein said actuator control element comprises an element (42) adapted to engage a first portion of the actuator (44) when the vanes are in the open and closed positions and the spring in its retracted position, and to engage a second portion of the actuator (44) to limit continued rotation of the drive mechanism and provide maximum extension of the spring and energy storage in the actuator.

13. An assembly according to claim 9 or 10, wherein each carrier comprises a rotary shaft (40) extending from said carrier and connected to said actuator (44), a driven gear in said carrier co-axially and rotatably mounted with respect to said shaft, wherein the energy storing and release means comprises a cam member (92) and wherein the cam member and driven gear (30) are provided with mutually interfitting camming surfaces movable out of interfitting engagement for coupling and uncoupling the gear and shaft for storing energy in the coupling means.

14. An assembly according to claim 13, including a spring for urging the driven gear towards coupling engagement with the cam member.

15. An assembly according to claim 9, wherein each

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actuator is carried on a rotary shaft (40) depending from said carrier, wherein said drive mechanism includes a driven gear (30) rotatably mounted around said shaft, a weight (80) mounted on said shaft over said driven gear for sliding movement on said shaft and rotation therewith, and wherein said energy storing and release means comprises a slip coupling between the weight and said gear for coupling the gear and the shaft during movement of the vanes between the open and closed positions, for lifting the weight out of coupling engagement with the gear when the actuator is arrested by encountering said resistance and for allowing the weight to fall back into coupling engagement with the gear accompanied by rotation of the shaft and actuator when said resistance is removed.

16. An assembly according to any one of claims 2 to 15, wherein said at least one carrier (158,352-360) comprises an end carrier connected to a movable end rail (102,342) connected to one vertical side edge of said shade member and wherein the opposite vertical edge of the shade member is fixed.

17. An assembly according to claim 16, wherein tilting of the vanes is effected by relative movement of said sheets.

18. An assembly according any one of claims 2 to 17, wherein an end one of said carriers (28',28A) comprises means (82,85) to adjust the height of the actuator (44A).

19. An assembly according to any one of claims 2 to 18, wherein an end one of said carriers (28',28A) comprises a rotary shaft (40A) extending from said carriage and connected to said actuator (44A), a driven gear (30A) in said carrier co-axially and rotatably mounted with respect to said shaft, adjusting means (82,85) for vertically adjusting the height and a cam member (90A), said cam member





and driven gear being provided with mutually interfitting cam surfaces (80A,81A) effective to raise said driven gear and with it the drive shaft and associated actuator (44A), when the vanes are turned to the open position.

20. An assembly according to any preceding claim, wherein at least one of said sheets is in the form of a sheer fabric.

21. An assembly according to claim 20, wherein both said sheets are sheer fabrics each of which has interstices of a different shape and/or orientation and/or size, to avoid the moire effect when said fabrics are in overlying relation.

22. An assembly according to claim 20 or 21, wherein said at least one sheet has dimensional stability in substantially mutually perpendicular directions (A, B), inclined to the vertical.

23. An assembly according to claim 21, wherein one of said fabrics is a tulle fabric having diamond shaped interstices (27), having a major axis and minor axis, said major axis extending substantially vertically and wherein the other of said fabrics comprises a knitted fabric including a plurality of generally parallel bundles of yarns (11) extending substantially vertically and a plurality of fill yarns (15,17,19,21) extending between the bundles of yarns at acute angles to the horizontal to provide said dimensional stability.

24. A window covering assembly comprising, in combination:-

- a) a wind-up roll (424) rotatable about its longitudinal axis;
- b) first and second fixing means (420,422) on said roll, said second fixing means being

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circumferentially spaced on said roll from said first fixing means;

c) a window covering (410) comprising:-

i) first and second generally parallel spaced apart, longitudinally extending, sheer fabrics (412,414) each having one end and an opposite end, said one end being fixed to said first and second fixing means respectively, and

ii) a plurality of longitudinally spaced generally parallel, transversely extending vanes (416), fixedly secured to said first and second sheer fabrics (412,414) to extend therebetween; and

d) an end rail (442) connected to the opposite end of one of said sheer fabrics, said end rail being movable towards and away from a said wind-up roll, initial rotation of roll causing said first and second sheer fabrics to move longitudinally relative to one another, effective to alter the angle of said vanes relative to said sheer fabrics, and further rotation of said roll winding said window covering onto said roll.

25. A window blind assembly comprising, in combination:-

a) an elongate tilt member (514) rotatable about its longitudinally axis;

b) first and second contact points on said tilt member at locations spaced circumferentially of said tilt member;

c) a front elongate sheer fabric (516) attached to said first connection point;

d) a plurality of transverse, parallel alternate forward and rearward pleats (518,520) formed in said fabrics;

e) a rear elongate sheer fabric (522) attached





to said second connection point;

f) a plurality of transverse parallel alternate forward and rearward pleats (524,526) formed in said rear sheer fabric; and

g) a plurality of substantially parallel opaque or semi-opaque vanes (528) having opposite side edges, one side edge of each vane being connected to the front sheer fabric and the other side edge being connected to the rear sheer fabric;

whereby, when tilt member is rotated in one sense, one of the sheer fabrics is moved longitudinally with respect to the other in one relative direction of movement the vanes are caused to lie parallel, thereby to allow passage of light through the blind, and when the tilt member is rotated in the other direction, the sheer fabrics are moved in the opposite relative direction of movement and the adjacent vanes are caused to at least partially block the passage of light through the blind.

26. A window covering assembly comprising:-

- i) a window covering comprising:-
 - a) a front elongate sheer fabric (516);
 - b) a plurality of transverse, parallel alternate forward and rearward pleats (518,520) formed in said front sheer fabric;
 - c) a rear elongate sheer fabric (522);
 - d) a plurality of transverse, parallel alternate forward and rearward pleats (524,526) formed in said rear sheer fabric; and
 - e) a plurality of substantially parallel opaque or semi-opaque vanes having opposite side edges, one side edge of each vane being connected to the front sheer fabric, the other side edge being connected to the rear

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sheer fabric;

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10
whereby when one of the sheer fabrics is moved longitudinally with respect to the other in one relative direction of movement, the vanes are caused to lie parallel thereby to allow passage of light through the blind and when the sheer fabrics are moved in the opposite relative direction of movement, the adjacent vanes are caused to at least partially block the passage of light through the blind;

15
ii) a horizontal guide track; and

iii) a plurality of sliding carriers connected to the upper end of at least some of said vanes and slidable in said track.

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27. A window covering assembly according to claim 26, further comprising means (542) to simultaneously rotate all of said vanes, whereby when said vanes are rotated in one sense, they are caused to lie parallel, thereby to allow passage of light through the blind, and when said vanes are tilted in the opposite sense, adjacent vanes are caused to overlap, thereby to block the passage of light through the blind.

This Sheet Has Been Replaced

