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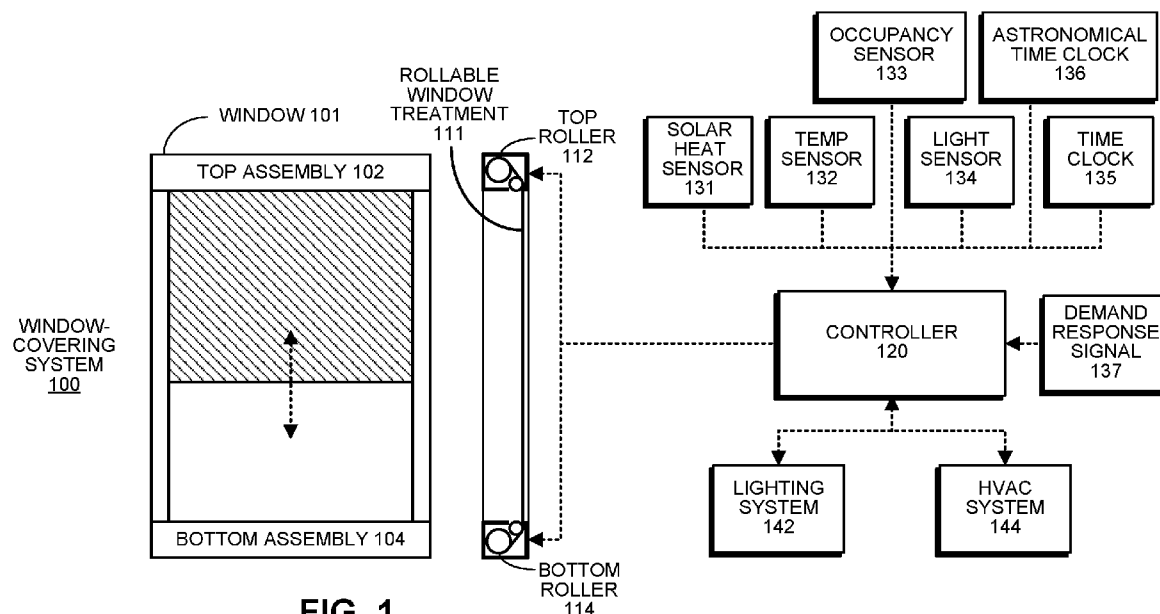
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(54) Title: A WINDOW-COVERING SYSTEM AND THE METHOD THEREOF



(57) Abstract: The disclosed embodiments relate to the design of a daylight management system for windows and skylights. This daylight management system includes a rollable window treatment comprising two or more different window-covering materials. It also includes a two-roller system that facilitates upward and downward rolling of the rollable window treatment, so that a selected portion of the rollable window treatment covers the window/skylight.

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A WINDOW-COVERING SYSTEM AND THE METHOD THEREOF

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CROSS-REFERENCE TO RELATED APPLICATION

[001] This application claims the benefit of U.S. Provisional Application Ser. No. 62/328,938, entitled “Multi-Material Rolling System for Window and Skylight Applications that Addresses Different Needs at Different Times,” by inventor Konstantinos Papamichael, Attorney Docket Number UC16-716-1PSP, filed on 28 April 2016, the contents of which are incorporated by reference herein.

BACKGROUND

Field

20

[002] The disclosed embodiments generally relate to managing daylight through building apertures, such as windows and skylights. More specifically, the disclosed embodiments relate to the design of a multi-material rolling system that can address changing needs, desires and/or environmental conditions.

25

Related Art

[003] The performance of window-covering systems depends on several factors, including outdoor daylight conditions and indoor occupancy-related needs and desires. Moreover, a wide variety of “window-covering” systems that provide various window treatments are available for windows and skylights to address these different needs, such as: providing a view; providing privacy; minimizing glare; and harvesting daylight for energy efficiency by reducing electric lighting, heating and cooling loads. Different window-covering systems can be

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used to address different combinations of such needs. However, there presently exists no window-covering system that addresses the many possible combinations of such needs.

[004] For example, a common type of window covering is a “window film.” Window films come in many different varieties, which can vary in transmittance (from low-to-high) and in type (from specular-to-diffuse). Most window systems use a selected film for a specific function, and the selected film is applied on the window/skylight glass area as a permanent treatment. This permanent treatment greatly limits the ability of the window/skylight system to address different performance needs as they change through time.

[005] Hence, what is needed is a window-covering system that effectively addresses changing daylight conditions and occupancy needs.

SUMMARY

[006] The disclosed embodiments relate to the design of a daylight management system for windows and skylights. This daylight management system includes a rollable window treatment comprising two or more different window-covering materials. It also includes a two-roller system that facilitates upward and downward rolling of the rollable window treatment, so that a selected portion of the rollable window treatment covers the window/skylight.

[007] In some embodiments, the rollable window treatment comprises consecutive sections of different window-covering materials.

[008] In some embodiments, the different window-covering materials include: one or more films; one or more fabrics; one or more screens; and any other type of window treatment that can be rolled.

[009] In some embodiments, the two-roller system includes a spring mechanism that keeps the rollable window treatment stretched.

[010] In some embodiments, the two-roller system provides a manual-operation mechanism.

[011] In some embodiments, the manual-operation mechanism comprises one or more of the following: a pull cord; a pull chain; and a manually activated motorized mechanism.

[012] In some embodiments, the two-roller system includes an automatic-operation mechanism. This automatic-operation mechanism includes a motorized-drive mechanism for the two-roller system that actuates the upward and downward rolling of the rollable window treatment. It also includes a controller that controls the motorized-drive mechanism.

[013] In some embodiments, the controller receives inputs from one or more of the following: occupancy sensor; solar heat sensor; temperature sensor; light sensor; and time or astronomical time clock.

[014] In some embodiments, the controller receives inputs about one or more of the following: a state of a lighting system for a building associated with the window/skylight; and a state of a heating, ventilation and air conditioning (HVAC) system for a building associated with the window/skylight.

5 [015] In some embodiments, during operation, the two-roller system positions the rollable window treatment so that a single window-covering material covers the window/skylight.

[016] In some embodiments, during operation, the two-roller system positions the rollable window treatment so that two or more different window-covering materials cover the
10 window/skylight.

[017] In some embodiments, the window-covering system is integrated into a frame of the window/skylight.

[018] In some embodiments, the window-covering system can be produced within its own frame of custom dimensions that can be added to existing windows and skylights.

15 BRIEF DESCRIPTION OF THE FIGURES

[019] FIG. 1 illustrates a window-covering system and an associated controller in accordance with the disclosed embodiments.

[020] FIGs. 2A-2F illustrate different window treatment combinations for the window-
20 covering system in accordance with the disclosed embodiments.

[021] FIG. 3 presents a flow chart illustrating operations performed by the window-covering system in accordance with the disclosed embodiments.

[022] FIG. 4 illustrates a computer system that controls the window-covering system in accordance with an embodiment of the present disclosure.

25 DETAILED DESCRIPTION

[023] The following description is presented to enable any person skilled in the art to make and use the present embodiments, and is provided in the context of a particular application and its requirements. Various modifications to the disclosed embodiments will be readily
30 apparent to those skilled in the art, and the general principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the present embodiments. Thus, the present embodiments are not limited to the embodiments shown, but are to be accorded the widest scope consistent with the principles and features disclosed herein.

[024] The data structures and code described in this detailed description are typically
35 stored on a computer-readable storage medium, which may be any device or medium that can

store code and/or data for use by a computer system. The computer-readable storage medium includes, but is not limited to, volatile memory, non-volatile memory, magnetic and optical storage devices such as disk drives, magnetic tape, CDs (compact discs), DVDs (digital versatile discs or digital video discs), or other media capable of storing computer-readable media now known or later developed.

[025] The methods and processes described in the detailed description section can be embodied as code and/or data, which can be stored in a computer-readable storage medium as described above. When a computer system reads and executes the code and/or data stored on the computer-readable storage medium, the computer system performs the methods and processes embodied as data structures and code and stored within the computer-readable storage medium. Furthermore, the methods and processes described below can be included in hardware modules. For example, the hardware modules can include, but are not limited to, application-specific integrated circuit (ASIC) chips, field-programmable gate arrays (FPGAs), and other programmable-logic devices now known or later developed. When the hardware modules are activated, the hardware modules perform the methods and processes included within the hardware modules.

[026] Various modifications to the disclosed embodiments will be readily apparent to those skilled in the art, and the general principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the present invention. Thus, the present invention is not limited to the embodiments shown, but is to be accorded the widest scope consistent with the principles and features disclosed herein.

Overview

[027] The disclosed embodiments provide a multi-material rolling window-covering system, which comprises two rollers that work together to facilitate upward and downward rolling of a rollable window treatment comprising different materials. This rollable window treatment can be composed of sections of one or more different materials, such as different films, fabrics, and screens. These different materials are connected together into a single rollable window treatment, which can roll up and down to expose different window treatment materials, wherein each different window treatment material can selectively cover the whole or different parts of the window opening.

[028] In this way, the system can provide different window treatments for different daylight conditions, such as overcast sky and partly cloudy or clear sky, with or without incident direct solar radiation. The ability to roll the different window treatment materials also makes it

possible to provide different treatments in different window areas. For example, a low-transmittance diffuse material can be used for the top part of a window to bring diffuse sunlight into a space, and a low-transmittance specular material can be used for the bottom part of the window to provide view of the outside. Note that any rolling or fixed material, which is presently used in existing window-covering systems, can also be used with the disclosed multi-material rolling system.

[029] Operation of the multi-material rolling system can be manual or, alternatively, automatic with a manual override. Manual operation can be achieved through standard rolling system mechanisms, such as pull cords or chains, or motorized with support for upward and downward movement. Motorized operation can be achieved using a motorized rolling system that rotates each cylinder (located in top and bottom sills) independently. For example, while one roller is actively rolling, the other roller can follow passively with a spring mechanism, which holds the window treatment material properly stretched. The motorized system can also support automated operation based on outdoor conditions and indoor needs, which can be determined through various sensors (e.g., occupancy, temperature, light, solar heat, etc.), time clocks and also the state of the electric lighting and HVAC systems, as well as demand response signals from utilities.

[030] This multi-material rolling system can be installed in new windows and skylights, and can also be retrofitted into existing windows and skylights, for example, by using a customized frame with a rolling mechanism to fit different sizes of existing window and skylight frames.

Implementation Details

[031] FIG. 1 illustrates a window-covering system 100 and an associated controller 120 in accordance with the disclosed embodiments. As illustrated in FIG. 1, window-covering system 100 covers a window 101 using a rollable window treatment 111, which feeds between a top roller 112 located in a top window assembly 102, and a bottom roller 114 located in a bottom window assembly 104.

[032] In some embodiments, window-covering system 100 is an automated system, which is operated by a computerized controller 120, that controls electric motors that selectively turn top roller 112 and bottom roller 114. Controller 120 can receive inputs from various sensors, such as: a solar heat sensor 131; a temperature sensor 132; an occupancy sensor 133; and a light sensor 134 (which can be located inside and/or outside of a structure associated with window 101). Controller 120 can also receive other types of information, such as: a time-of-day from a time clock 135; sunrise/sunset from an astronomical time clock 136; the state of a lighting

system 142; the state of an HVAC system 144; and a demand response (DR) signal 137 for utilities. These inputs are used to control top roller 112 and bottom roller 114 to position an appropriate window treatment, which is determined from the inputs, to cover window 101. Note that controller 120 can also control lighting system 142 and HVAC system 144 concurrently with
5 controlling window-covering system 100.

[033] FIGs. 2A-2F illustrate different window-covering combinations for window-covering system 100 in accordance with the disclosed embodiments. FIG. 2A illustrates a window-covering comprising an 80% specular transmittance window treatment covering a top portion of the window, and a clear window treatment covering a bottom portion of the window.
10 As the rollable window treatment rolls down, the 80% specular transmittance window treatment covers the entire window as is illustrated in FIG. 2B. As the rollable window treatment rolls down further, a 50% specular transmittance window treatment covers the top portion of the window, and the 80% specular transmittance window treatment covers the bottom portion of the window as is illustrated in FIG. 2C. As the rollable window treatment rolls down even further,
15 the 50% specular transmittance window treatment covers the entire window as is illustrated in FIG. 2D. When the rollable window treatment rolls down again, a 20% specular transmittance window treatment covers the top portion of the window, and the 50% specular transmittance window treatment covers the bottom portion of the window as is illustrated in FIG. 2E. Finally, when the rollable window treatment rolls down further, a 20% diffuse transmittance window
20 treatment covers the top portion of the window, and the 20% specular transmittance window treatment covers the bottom portion of the window as is illustrated in FIG. 2F.

Operation of a Control System for a Window/Skylight

[034] FIG. 3 presents a flow chart illustrating operations performed by the window-covering system 100 in accordance with the disclosed embodiments. During operation, window-covering system 100 actuates the two-roller system to control upward and/or downward rolling of a rollable window treatment, so that a selected portion of the rollable window treatment covers the window/skylight, wherein the rollable window treatment comprises two or more different window-covering materials (step 302). During this process, the window-covering system uses a
30 spring mechanism in the two-roller system to keep the rollable window treatment stretched (step 304).

Computer System

[035] FIG. 4 illustrates an exemplary implementation of computer system 400, which
35 can be used to implement controller 120 illustrated in FIG. 1, which controls operation of the

window-covering system. As illustrated in FIG. 4, computer system 400 includes: a processing subsystem 406 with one or more processors, a memory subsystem 408 (with memory), and a network connection 410, which is coupled to an external network (not shown).

[036] In general, computer system 400 can be implemented using a combination of hardware and/or software. Thus, computer system 400 may include one or more program modules or sets of instructions stored in a memory subsystem 408 (such as DRAM or another type of volatile or non-volatile computer-readable memory), which, during operation, may be executed by processing subsystem 406. Furthermore, instructions in the various modules in memory subsystem 408 may be implemented in: a high-level procedural language, an object-oriented programming language, and/or in an assembly or machine language. Note that the programming language may be compiled or interpreted, *e.g.*, configurable or configured, to be executed by the processing subsystem.

[037] Components in computer system 400 may be coupled by signal lines, links or buses, for example bus 404. These connections may include electrical, optical, or electro-optical communication of signals and/or data. Furthermore, in the preceding embodiments, some components are shown directly connected to one another, while others are shown connected via intermediate components. In each instance, the method of interconnection, or “coupling,” establishes some desired communication between two or more circuit nodes, or terminals. Such coupling may often be accomplished using a number of photonic or circuit configurations, as will be understood by those of skill in the art; for example, photonic coupling, AC coupling and/or DC coupling may be used.

[038] In some embodiments, functionality in these circuits, components and devices may be implemented in one or more: application-specific integrated circuits (ASICs), field-programmable gate arrays (FPGAs), and/or one or more digital signal processors (DSPs). Furthermore, functionality in the preceding embodiments may be implemented more in hardware and less in software, or less in hardware and more in software, as is known in the art. In general, computer system 400 may be at one location or may be distributed over multiple, geographically dispersed locations.

[039] Computer system 400 may include, but is not limited to: a server (such as a multi-socket, multi-rack server), a laptop computer, a communication device or system, a personal computer, a work station, a mainframe computer, a blade, an enterprise computer, a data center, a tablet computer, a supercomputer, a network-attached-storage (NAS) system, a storage-area-network (SAN) system, a media player (such as an MP3 player), an appliance, a subnotebook/netbook, a tablet computer, a smartphone, a cellular telephone, a network appliance, a set-top box, a personal digital assistant (PDA), a toy, a controller, a digital signal processor, a

game console, a device controller, a computational engine within an appliance, a consumer-electronic device, a portable computing device or a portable electronic device, a personal organizer, and/or another electronic device.

5 [040] Various modifications to the disclosed embodiments will be readily apparent to those skilled in the art, and the general principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the present invention. Thus, the present invention is not limited to the embodiments shown, but is to be accorded the widest scope consistent with the principles and features disclosed herein.

10 [041] The foregoing descriptions of embodiments have been presented for purposes of illustration and description only. They are not intended to be exhaustive or to limit the present description to the forms disclosed. Accordingly, many modifications and variations will be apparent to practitioners skilled in the art. Additionally, the above disclosure is not intended to limit the present description. The scope of the present description is defined by the appended claims.

What Is Claimed Is:

1. A window-covering system for a window/skylight, comprising:
a rollable window treatment comprising two or more different window-covering
5 materials; and
a two-roller system that facilitates upward and downward rolling of the
rollable window treatment, so that a selected portion of the rollable window treatment covers the
window/skylight.

2. The window-covering system of claim 1, wherein the rollable window treatment
comprises consecutive sections of different window-covering materials.

3. The window-covering system of claim 2, wherein the different window-covering
materials include:

one or more films;
one or more fabrics;
one or more screens; and
one or more materials that can be rolled.

4. The window-covering system of claim 1, wherein the two-roller system includes a
spring mechanism that keeps the rollable window treatment stretched.

5. The window-covering system of claim 1, wherein the two-roller system provides a
manual-operation mechanism.

6. The window-covering system of claim 5, wherein the manual-operation
mechanism comprises one or more of the following:

a pull cord;
a pull chain; and
a manually activated motorized mechanism.

7. The window-covering system of claim 1, wherein the two-roller system includes
an automatic-operation mechanism, comprising:

a motorized-drive mechanism for the two-roller system that actuates the upward and
downward rolling of the rollable window treatment; and

a controller that controls the motorized-drive mechanism.

8. The window-covering system of claim 6, wherein the controller receives inputs from one or more of the following:

- 5 an occupancy sensor;
- a solar heat sensor;
- a temperature sensor;
- a light sensor;
- a time clock; and
- 10 an astronomical time clock.

9. The window-covering system of claim 6, wherein the controller receives inputs about one or more of the following:

- a state of a lighting system for a building associated with the window/skylight;
- 15 a state of a heating, ventilation and air conditioning (HVAC) system for a building associated with the window/skylight; and
- a demand response (DR) signal from an electric utility.

10. The window-covering system of claim 1, wherein during operation, the two-roller
20 system positions the rollable window treatment so that a single window-covering material covers the window/skylight.

11. The window-covering system of claim 1, wherein during operation, the two-roller
system positions the rollable window treatment so that two or more different window-covering
25 materials cover the window/skylight.

12. The window-covering system of claim 1, wherein the window-covering system is integrated into a frame of the window/skylight.

30 13. A method for operating a window-covering system for a window/skylight, comprising:

actuating a two-roller system to control upward and/or downward rolling of a rollable window treatment, so that a selected portion of the rollable window treatment covers the window/skylight;

wherein the rollable window treatment comprises two or more different window-covering materials.

14. The method of claim 13, wherein the rollable window treatment comprises consecutive sections of different window-covering materials.

15. The method of claim 13, wherein the different window-covering materials include:

one or more films;
one or more fabrics;
one or more screens; and
one or more materials that can be rolled.

16. The method of claim 13, wherein the method further comprises using a spring mechanism in the two-roller system to keep the rollable window treatment stretched.

17. The method of claim 13, wherein actuating the two-roller system includes using a manual-operation mechanism to actuate the two-roller system.

18. The method of claim 17, wherein the manual-operation mechanism comprises one or more of the following:

a pull cord;
a pull chain; and
a manually activated motorized mechanism.

19. The method of claim 13, wherein actuating the two-roller system includes using an automatic-operation mechanism to actuate the two-roller system, which involves:

using a motorized-drive mechanism for the two-roller system to actuate the upward and downward rolling of the rollable window treatment; and

using a controller to control the motorized-drive mechanism.

20. The method of claim 19, wherein the controller receives inputs from one or more of the following:

an occupancy sensor;
a solar heat sensor;

a temperature sensor;
a light sensor;
a time clock; and
an astronomical time clock.

5

21. The method of claim 19, wherein the controller receives inputs about one or more of the following:

a state of a lighting system for a building associated with the window/skylight;
a state of a heating, ventilation and air conditioning (HVAC) system for a building

10 associated with the window/skylight;

and

a demand response (DR) signal from an electric utility.

22. The method of claim 13, wherein during operation, the two-roller system positions the rollable window treatment so that a single window-covering material covers the window/skylight.

15

23. The method of claim 13, wherein during operation, the two-roller system positions the rollable window treatment so that two or more different window-covering materials cover the window/skylight.

20

24. The method of claim 13, wherein the window-covering system is integrated into a frame of the window/skylight.

25 25. A window/skylight, comprising:

a frame that encloses the window/skylight;

a transparent material housed in the frame;

a window-covering system integrated into the frame, comprising:

a rollable window treatment comprising two or more different window-

30 covering materials; and

a two-roller system that facilitates upward and downward rolling of the rollable window treatment, so that a selected portion of the rollable window treatment covers the window/skylight.

26. The window/skylight of claim 25, wherein the rollable window treatment comprises consecutive sections of different window-covering materials.

27. The window/skylight of claim 26, wherein the different window-covering materials include:

- one or more films;
- one or more fabrics;
- one or more screens; and
- one or more materials that can be rolled.

28. The window/skylight of claim 25, wherein the two-roller system includes a spring mechanism that keeps the rollable window treatment stretched.

29. The window/skylight of claim 25, wherein the two-roller system provides a manual-operation mechanism.

30. The window/skylight of claim 29, wherein the manual-operation mechanism comprises one or more of the following:

- a pull cord;
- a pull chain; and
- a manually activated motorized mechanism.

31. The window/skylight of claim 25, wherein the two-roller system includes an automatic-operation mechanism, comprising:

- a motorized-drive mechanism for the two-roller system that actuates the upward and downward rolling of the rollable window treatment; and
- a controller that controls the motorized-drive mechanism.

32. The window/skylight of claim 31, wherein the controller receives inputs from one or more of the following:

- an occupancy sensor;
- a solar heat sensor;
- a temperature sensor;
- a light sensor;
- a time clock; and

an astronomical time clock.

33. The window/skylight of claim 31, wherein the controller receives inputs about one or more of the following:

- 5 a state of a lighting system for a building associated with the window/skylight; and
 a state of a heating, ventilation and air conditioning (HVAC) system for a building associated with the window/skylight.

34. The window/skylight of claim 25, wherein during operation, the two-roller system
10 positions the rollable window treatment so that a single window-covering material covers the window/skylight.

35. The window/skylight of claim 25, wherein during operation, the two-roller system
15 positions the rollable window treatment so that two or more different window-covering materials cover the window/skylight.

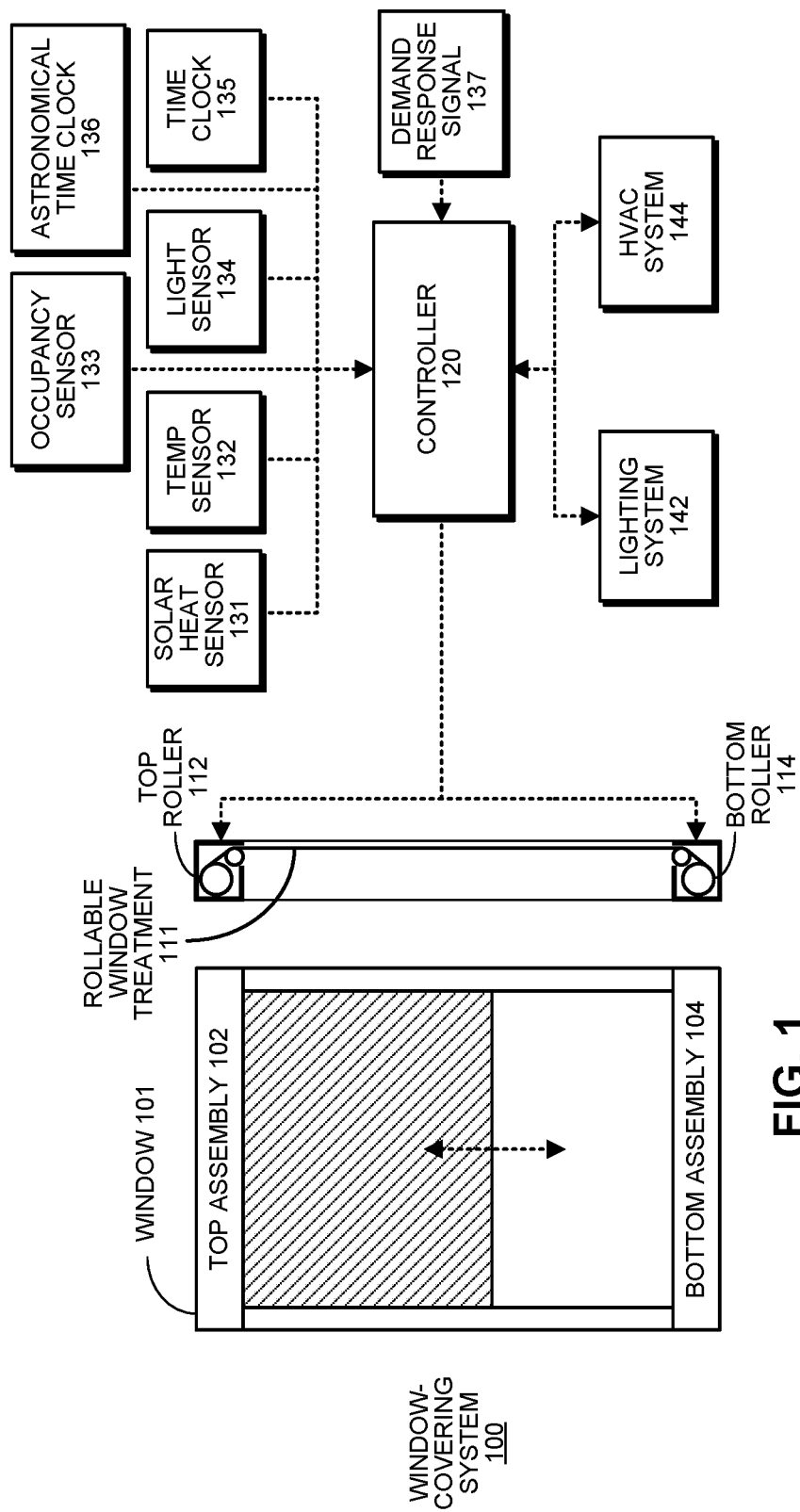


FIG. 1

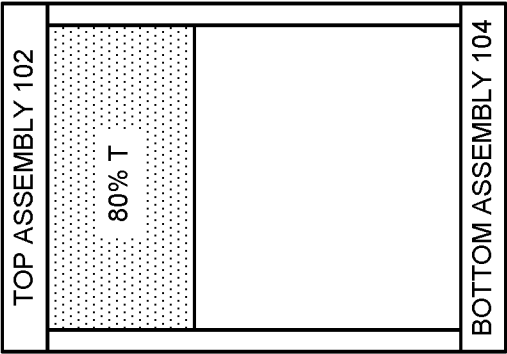


FIG. 2A

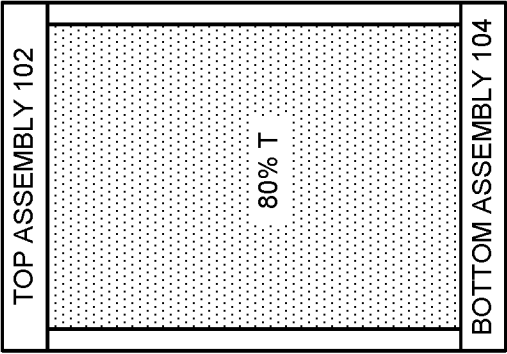


FIG. 2B

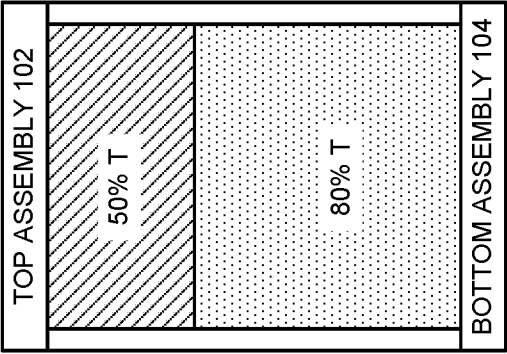


FIG. 2C

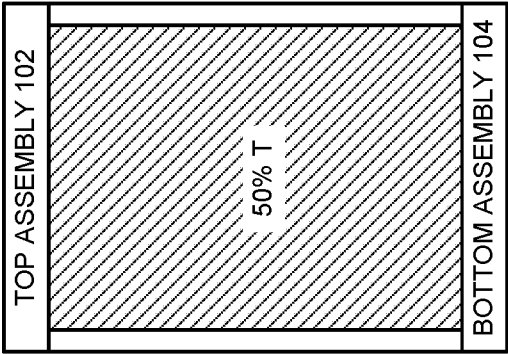


FIG. 2D

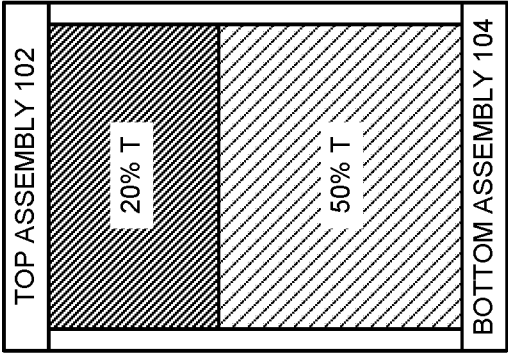


FIG. 2E

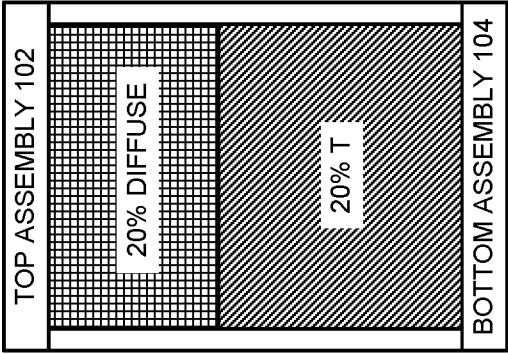
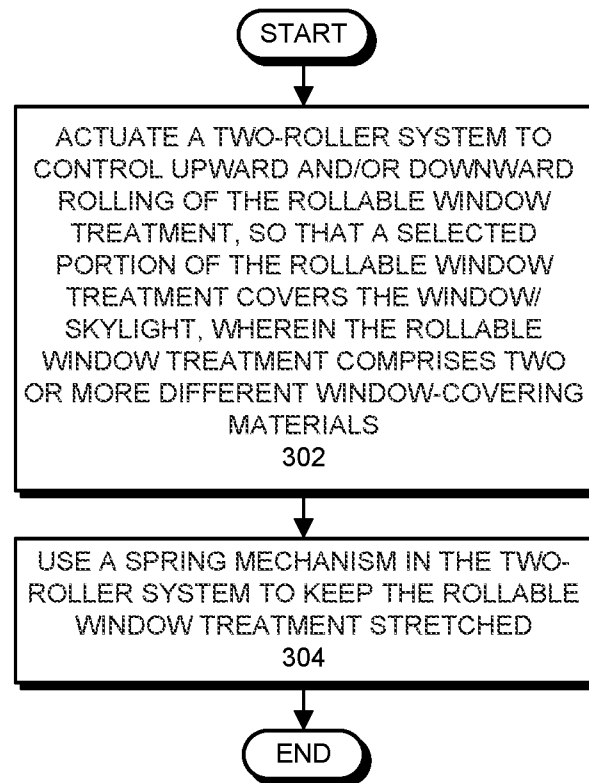


FIG. 2F

**FIG. 3**

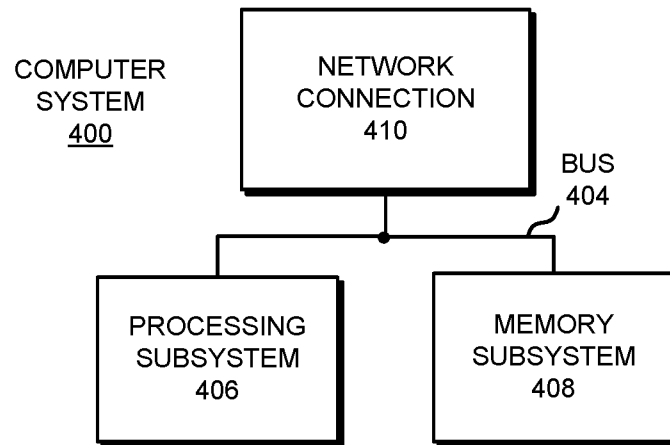


FIG. 4

A. CLASSIFICATION OF SUBJECT MATTER**E06B 9/68(2006.01)i, E06B 9/64(2006.01)i, E06B 9/66(2006.01)i, E06B 9/17(2006.01)i, E06B 9/42(2006.01)i**

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 9/68; A47H 1/00; H05B 37/02; E06B 9/08; E06B 9/40

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: window/skylight, window-covering system, rollable window treatment, different window-covering materials, two-roller system

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2003-0234087 A1 (JONES, MARVIN L.) 25 December 2003 See paragraphs [0002], [0017]-[0029]; and figures 1-2.	1-6, 10-18, 22-30 , 34-35
Y		7-9, 19-21, 31-33
Y	EP 2787162 A1 (SAGE ELECTROCHROMICS, INC. et al.) 08 October 2014 See paragraphs [0002], [0018]-[0039], [0043]-[0053]; and figures 1-2, 4-5.	7-9, 19-21, 31-33
X	US 2005-0224190 A1 (HUANG, WEN-CHONG) 13 October 2005 See paragraphs [0002], [0016]-[0023]; and figures 1, 3-7.	1-3, 5-6, 10-15 , 17-18, 22-27, 29-30 , 34-35
A	US 2009-0242143 A1 (PHAM, DUNG VIET) 01 October 2009 See paragraphs [0018]-[0026]; and figure 1.	1-35
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Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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