SPACE DIVISION SYSTEM WITH MATERIAL SUPPORT LINKAGE

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ABSTRACT

A space division system (600) includes side sections (604) connected to an overhead structural channel system (606) through support pole assemblies (617). Material support linkage assemblies (610) include an upper material support linkage assembly (614) and a lower material support linkage assembly (612) coupled to the side sections (604). The material support linkage assemblies (610) include adjustable links (616) pivotable relative to each other for forming various configurations of the space division system (600).
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CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority of U.S. Provisional Application Ser. No. 60/605,874 filed Aug. 31, 2004.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

REFERENCE TO A MICROFICHE APPENDIX

[0003] Not applicable.

BACKGROUND OF THE INVENTION

[0004] 1. Field of the Invention
[0005] The invention relates to systems for providing vertically disposed space division systems and, more particularly, to a flexible system which employs lightweight and rapidly reconfigurable elements with internal stretch characteristics, and with material support linkage means for providing pivoted reconfigurations of spaced elements.

[0006] 2. Background Art
[0007] Building infrastructure continue to evolve in today's commercial, industrial and office environments. For purposes of description in this specification, the term “commercial interiors” shall be used to collectively designate these environments. Such environments may include, but are clearly not limited to, retail facilities, medical and other health care operations, educational, religious and governmental institutions, factories and others. Historically, infrastructure consisted of large rooms with fixed walls and doors. Lighting, heating and cooling (if any) were often centrally controlled. Commercial interiors would often be composed of large, heavy and “stand-alone” equipment and operations, such as in factories (e.g., machinery and assembly lines), offices (desk and files), retail (built-in counters and shelves) and the like. Commercial interiors were frequently constructed with very dedicated purposes in mind. Given the use of stationary walls and heavy equipment, any reconfiguration of a commercial interior was a time-consuming and costly undertaking.

[0008] In the latter part of the 20th century, commercial interiors began to change. A major impetus for this change was the need to accommodate the increasing “automation” that was being introduced in the commercial interiors and, with such automation, the need for electrical power to support the same. The automation took many forms, including: (i) increasingly sophisticated machine tools and powered equipment in factories; (ii) electronic cash registers and security equipment in retail establishments; (iii) electronic monitoring devices in health care institutions; and (iv) copy machines and electric typewriters requiring high voltage power supplies in office environments. In addition, during this period of increased automation, other infrastructure advancements occurred. For example, alternative lighting approaches (e.g., track lighting with dimmer control switches) and improved air ventilation technologies were introduced, thereby placing additional demands on power availability and access.

[0009] In recent decades, information technology has become commonplace throughout commercial interiors. Computer and computer-related technologies have become ubiquitous. As an example, computer-numerically-controlled (CNC) production equipment has been applied extensively in factory environments. Point-of-sale electronic registers and scanners are commonplace in retail establishments. Sophisticated computer simulation and examination devices are used throughout medical institutions. Increased sophistication of computer electronics associated with the examination devices is particularly increasing rapidly, with regard to the greater use of "noninvasive" procedures. Modular systems furniture has evolved to support the computers and related hardware used throughout office environments. The proliferation of computers and information technology has resulted not only in additional demands for power access and availability, but also in a profusion of wires needed to power and connect these devices into communications networks. These factors have added considerably to the complexity of planning and managing commercial interiors.

[0010] The foregoing conditions can be characterized as comprising: dedicated interior structures with central control systems; increasing needs for power and ready access for power; and information networks and the need to manage all of the resulting wire and cable. The confluence of these conditions has resulted in commercial interiors being inflexible and difficult to change. Today's world requires businesses and institutions to respond quickly to "fast-changing" commercial interior needs.

[0011] In general, these types of systems as developed over the past several decades can be somewhat characterized as permitting "partial" rearrangement of architectural interiors, and somewhat of an advancement in organizing interior space. Although the term "modular" is sometimes used to describe these types of systems, they did not fit within the true definition of a modular system. Instead, these systems are inherently "closed systems," and are limited to finite sets of interchangeable physical parts.

[0012] With respect to all of the known space division systems, each suffers from a number of various disadvantages. For example, many of the architectural interiors in existence today actually result in an "overperformance." That is, they have weight, bulk and other size parameters which are clearly unnecessary for their desired functionality. Their cost is significant. This cost occurs not only from initial acquisition prices, but also, as a result of their lack of true flexibility, from costs associated with moving or reconfiguring the interiors. Also, in part, additional costs result from the fact that reconfiguration of such systems often results in wastes of component parts. In this same regard, many component parts of known systems are not reusable when disassembled.

[0013] Still further, known space-division systems for many reasons (including those previously stated herein), do not lend themselves to any type of "rapid" reconfiguration. In fact, they may require a significant amount of work to reconfigure. This work often requires use of trained specialists. Also, reconfiguration of known space division systems may involve additional physical wiring or substantial rewiring. Different trained specialists may be required when the reconfiguration in any manner involves such electrical or data/communications components. Still further, although these systems may involve lighting controllable by a workspace user, many environmental functions remain centrally controlled, often in locations substantially remote from the architectural interior being controlled.

[0014] Other disadvantages also exist with respect to these known systems. For example, space dividers in use today are
often “ground-based,” meaning that they are supported and extend upwardly from floor structures. Many of these configurations are limited in height, and do not particularly lend themselves to visual privacy. Also, as a result of the lack of flexibility and inherent problems with reconfiguration, known systems do not facilitate reconfiguration of space divider groupings, for purposes of individual privacy, collaboration and other “interaction” characteristics.

[0015] As earlier mentioned, known space division systems still do not particularly assist in providing an occupant’s control of his or her own environmental conditions. Even further, however, difficulties can arise in known space division systems when environmental characteristic control is provided within a general space of an occupant. For example, lighting associated with an occupant’s usage area may be controlled by a switch which is initially relatively close in proximity and readily accessible. However, if this interior space is reconfigured in any substantial manner, the switch controlling the lighting may no longer be accessible or otherwise located in a functionally “correct” position. In this regard, known systems have no capability of providing any relatively rapid reconfiguration of controlling/controlled relationships among functional elements, such as switches, task lights, data terminals and the like. Also, to the extent these relationships are reconfigured, substantial rewiring by personnel having significant technical expertise will be required.

[0016] Another significant disadvantage with known space divider systems relates to their lack of development in light of advances in technology. However, many of these technological advances have modified today’s business, educational and personal work practices. Two examples of relatively recent technological advances consist of the semiconductor revolution and the corresponding miniaturization of numerous electrical and data/communications components. Today, the work practices of many individuals involve the use of laptop computers and other portable, electronic devices. Many of these devices have the capability of operating on DC power. However, most of today’s space division systems do not provide for availability of such power. In addition, known systems do not provide any other features which will facilitate efficiency in today’s new work practices, such as ready access to data storage and the like.

[0017] The foregoing is only a brief description of some of the disadvantages associated with current development in architectural interiors and space division systems. In part, disadvantages exist because of today’s business practices. The following paragraphs briefly describe other aspects of today’s activities in the areas of architecture and design, and why the foregoing disadvantages of known systems are becoming even more important.

[0018] In the past, problems associated with difficulty in reconfiguration of architectural interiors, and lack of in situ control of a location’s environmental conditions, may not have been of primary concern. However, today’s business climate often involves relatively “fast changing” architectural interior needs. Architectural interiors may be structurally designed by designers, architects and engineers, and initially laid out in a desired format with respect to lighting fixtures, switches, data lines, and other functional accessories. However, when these structures, which can be characterized as somewhat “permanent” in most buildings (as described in previous paragraphs herein), are designed, the actual occupants may not move into the building for several years. Designers need to “anticipate” the needs of future occupants of the building being designed. Needless to say, in situations where the building will not be commissioned for several years after the design phase, the architectural interior of the building may not be appropriately laid out for the actual occupants. That is, the prospective tenants’ needs may be substantially different from the designers’ anticipated ideas and concepts. However, as previously described herein, most architectural interiors permit little reconfiguration after completion of the initial design. Reconfiguring of structures in accordance with the needs of a particular tenant can be extremely expensive and time-consuming. During structural modifications, the architectural interior is essentially “down” and provides no positive cash flow to the buildings’ owners.

[0019] It would be advantageous to always have the occupants’ activities and needs “drive” the structure and function of the architectural interior layout. To date, however, many relatively “stationary” (in function and structure) interiors essentially operate in reverse. That is, it is not uncommon for prospective tenants to evaluate a building’s architectural interiors and determine how to “fit” their needs (workspaces, conference rooms, lighting, heating, ventilation and air conditioning (“HVAC”) requirements and the like) into the existing architectural interiors.

[0020] Still further, and again in today’s business climate, a prospective occupant may have had an opportunity to be involved in the design of a building’s architectural interior, so that the interior is advantageously “set up” for the occupant. However, many business organizations today experience relatively rapid changes in growth, both positively and negatively. When these changes occur, again it may be difficult to appropriately modify the architectural interior so as to permit the occupant to expand beyond its original architectural interior or, alternatively, be reduced in size such that unused space can be occupied by another tenant.

[0021] The foregoing paragraphs describe reconfiguration as a result of delay time between original design and the time when users actually occupy space, as well as situations where reconfiguration is required as a result of a business organization’s growth or other “external” conditions requiring reconfiguration. In addition, it would also be advantageous to reconfigure architectural interiors substantially on a “real time” basis, where the needs of the occupants change almost instantaneously. That is, the time period required for reconfiguration need not be of any substantial length of otherwise involve changes in a business climate for a particular occupant.

[0022] As an example, it may be advantageous for the occupant of a particular architectural interior to have a specific layout during morning and evening hours, while having a revised layout during mid-day hours. This could occur, for example, in an educational learning center, where usage of the architectural interior by students may change, for example, from primarily “individual” usage in the morning and evening hours, to joint projects and meeting activities requiring collaborative usage during mid-day hours. For such usage, it may be particularly advantageous to have the capability of rapidly modifying interconnections of individual space dividers, providing projection services, and facilitating relocation of laptops, task lighting and the like.

[0023] Other problems also exist with respect to the layout and organization of today’s architectural interiors. For example, and as earlier described herein, accessories such as switches and lights may be relatively “set” with regard to
locations and particular controlling relationships between such switches and lights. That is, one or more particular switches may control one or more particular lights. To modify these control relationships in most architectural interiors requires significant efforts. In this regard, an architectural interior can be characterized as being "delivered" to original occupants in a particular "initial state." This initial state is defined by not only the physical locations of functional accessories, but also the control relationships among switches, lights and the like. It would be advantageous to provide means for essentially "changing" the relationships in a relatively rapid manner, without requiring physical rewiring or similar activities. In addition, it would also be advantageous to have the capability of modifying physical locations of various functional accessories, without requiring additional electrical wiring, substantial assembly or disassembly of component parts, or the like. Still further, it would be advantageous if users of a particular area could effect control relationships among functional accessories and other utilitarian elements at the location of the architectural interior itself.

Various types of space division systems are known in the prior art. For example, Roberts, U.S. Pat. No. 5,274,970 issued Jan. 4, 1994, discloses a freestanding space division system having upstanding posts for resting on the floor. At least one rail assembly is extended between adjacent posts and spaced from the floor. Saddles hung from the rail assembly, and trays are suspended from the saddles so as to form raceways. Vertical pole assemblies are detachably mounted to each post and extend "axially" so that a pair of adjacent pole assemblies on a rail can define a panel receiving space.

Goodman, et al., U.S. Pat. No. 6,047,508 issued Apr. 11, 2000, discloses a wall panel space division system having a movable panel with a rigid frame. A core panel is mounted in the frame, and at least one cover panel is detachably mounted on the frame and encloses an associated portion. The frame has at least one vertical stile with first and second channels that extend longitudinally therealong. The stiles are shaped to receive utilities through outwardly opening sides. The outwardly opening sides of the panels are juxtaposed in opposing directions, so as to facilitate routing utilities along both faces of the panel. A variable height frame support may be positioned between the top of the panel and the building ceiling for floor-to-ceiling applications.

**SUMMARY OF THE INVENTION**

In accordance with the invention, a space division system is used with an overhead system within a building infrastructure. The space division system includes a series of vertical panels having side sections. This system also includes upper and lower material support linkage assemblies. Each of the linkage assemblies include adjustable links having pivot means for permitting pivotal movement between the adjustable links of the material support linkage assemblies.

**BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING**

The invention will now be described with reference to the drawings, in which:

**FIG. 1** is an example embodiment of one space divider within a space division system with technology in accordance with the invention, with the space divider hung from a rail system having communications, and with the space divider displaying certain SSL lighting technology;

**FIG. 2** is a plan view of an office environment showing the space division system in accordance with the invention, in various configurations;

**FIG. 3** is a side elevational view of the system, showing the space divider with 3D translucency, and with the use of stretch material;

**FIG. 4** is an end view of the space divider of FIG. 3, showing material characteristics and taken along section lines 4-4 of FIG. 3;

**FIG. 5** illustrates a space divider in accordance with the invention, utilizing what is characterized as "cattle mattress" material, with FIG. 5 being a side elevational view;

**FIG. 6** is a sectional end view, taken along section lines 6-6 of FIG. 5, for purposes of showing material characteristics;

**FIG. 7** is a perspective view of the space dividers of the space division system in accordance with the invention;

**FIG. 8** is a partial sectional view of the bottom and top detail of the space dividers in FIG. 7, taken along section lines 8-8 of FIG. 7;

**FIG. 8A** is an end view of an alternative embodiment for an articulated bottom which may be utilized with the space dividers of FIG. 7;

**FIG. 8B** is a perspective view of the alternative embodiment illustrated in FIG. 8A;

**FIG. 9** is an end sectional view of a section of the space dividers shown in FIG. 7, taken along section lines 9-9 of FIG. 7;

**FIG. 10** is a section of the junction between the adjoining space dividers shown in FIG. 7, and taken along section lines 10-10 of FIG. 7;

**FIG. 11** is a "close up" sectional view of an end portion of a wall of the space division system in accordance with the invention, illustrating the use of 3D translucent material, and also showing power/communication cables extending through a pre-woven pocket;

**FIG. 12** is a "close up" sectional view of the junction of the two space dividers in FIG. 7, illustrating the use of 3D translucent material, and also showing power/communication cables extending through the pre-woven portion of the pocket;

**FIG. 13** is a "close up" sectional view of an end portion of the wall shown in FIG. 7, with the space divider utilizing "cattle mattress" material, and with power/communication cables from the rail system extending through the pre-woven pocket;

**FIG. 14** is a "close up" sectional view of the junction of two space dividers utilizing the "cattle mattress" material, and also showing the power/communication cables extending through the pre-woven pocket;

**FIG. 15** is a side elevational view of one of the space dividers of the space division system in accordance with the invention, illustrating the use of internal LED light technology;

**FIG. 16** is a sectional end view of details of the internal LED light technology of FIG. 15, taken along section lines 16-16 of FIG. 15, and illustrating the concept of utilizing a pattern having a flexibility of location for color wash or signaling, and further illustrating the concept of channel voids being integral to the fabric;
FIG. 17 is a side elevational view of a partition panel of the space division system in accordance with the invention, illustrating another arrangement for use of internal LED light technology;

FIG. 18 is a sectional end view of a portion of the space divider shown in FIG. 17, taken along section lines 18-18 of FIG. 17;

FIG. 19 is a side elevational view of space dividers of the space division system in accordance with the invention, illustrating another configuration of the internal LED light technology utilized with the space dividers;

FIG. 20 is a sectional end view of a portion of the space divider illustrated in FIG. 19, taken along section lines 20-20 of FIG. 19;

FIG. 21 is a side elevational view of a space divider of the space division system in accordance with the invention, and illustrating another embodiment of the use of internal LED light technology with the space divider;

FIG. 22 is a sectional end view showing a portion of the space divider of FIG. 21, taken along section lines 22-22 of FIG. 21;

FIG. 23 is an alternative sectional end view taken from FIG. 21, and showing the use of the LED light technology in a manner which may be important for emergency directional lighting, and illustrating the use of internal LED lighting on both sides of a space divider;

FIG. 24 is a side elevation view of a space divider of the space division system in accordance with the invention, and illustrating the use of internal LED technology with arrows;

FIG. 25 is a side elevational view of a space divider of the space division system in accordance with the invention, and showing the use of external LED light technology, so as to provide a "color wash" along one side of the space divider;

FIG. 26 is a sectional end view of the space divider illustrated in FIG. 25, and taken along section lines 26-26 of FIG. 25;

FIG. 27 is a side elevational view of space dividers of the space division system in accordance with the invention, and illustrating the use of the space dividers with power and data storage;

FIG. 28 is a side elevational view of the use of space dividers of the space division system in accordance with the invention, and further showing the use of SSL task lighting technology with the space dividers;

FIG. 29 is a front elevational view, illustrating the task lighting technology of FIG. 28;

FIG. 30 is a perspective view showing a curved space divider, and further showing the use of task lighting technology with the space divider;

FIG. 31 is a side elevational view of space dividers of the space division system in accordance with the invention, and showing DC low voltage technologies associated with the space dividers;

FIG. 32 is a side elevation view of space dividers of the space division system in accordance with the invention, illustrating various office environment technologies incorporated with the space dividers, and further illustrating the use of Velcro clips on attachment points;

FIG. 33 is a side elevational view of space dividers of the space division system in accordance with the invention, showing the space dividers with use of technology in a temporary work or gathering space, where the technology may comprise data storage switches, headphones, projection screens and the like;

FIG. 34 is a top plan view of a mockup office environment similar to that of FIG. 2, but showing the use of a projector and screen with one of the configurations of the space dividers;

FIG. 35 is a plan view of one embodiment of a shape of space dividers of the space division system in accordance with the invention;

FIG. 36 is a plan view of a further embodiment of the use of space dividers of the space division system in accordance with the invention;

FIG. 37 is a plan view of a still further embodiment of the use of the technology curtains of the space division system in accordance with the invention;

FIG. 38 is a plan view of a particular configuration of the space dividers characterized as a "flutter" form;

FIG. 39 is a plan view of a further embodiment of a "flutter" form configuration of the space dividers;

FIG. 40 is a plan view of a configuration of the space dividers, with the configuration illustrating positions of individual and collective space, and with FIG. 40 specifically illustrating a "quad-place" configuration;

FIG. 41 is a plan view of a further embodiment of a "quad-place" configuration, with the embodiments of FIGS. 40 and 41 showing individual and collective space, and moving to more collectivity with a less flexible central passageway, where the space grows so as to accommodate group work;

FIG. 42 is a plan view of space dividers of the space division system in accordance with the invention, in a configuration which illustrates a "triplace" configuration, having three spaces;

FIG. 43 is a plan view of an alternative embodiment, illustrating a single space configuration;

FIG. 44 is a plan view of a third alternative embodiment, illustrating a configuration with two spaces;

FIG. 45 is a perspective view of a translucent partition panel of the space division system in accordance with the invention, in use;

FIG. 46 is a perspective view of a user employing a control wand for purposes of reconfiguring control relationships among technologies associated with the space division system, with the user working on control relationships associated with activation of LED technologies on the space dividers;

FIG. 47 illustrates a perspective view of a user employing the control wand for purposes of working on control relationships associated with the task lighting technologies of the space division system;

FIG. 48 is a perspective view of a control wand which may be utilized in accordance with the invention;

FIG. 49 is a plan view of the control wand of FIG. 48;

FIG. 50 is a front elevational view of the control wand of FIG. 48;

FIG. 51 is a perspective view of an arrangement of a partition panel of the space division system in accordance with the invention, using task lighting technologies in an arrangement which could be employed for a library, study hall, restaurant or similar environment;
FIG. 52 is a perspective view of one embodiment of a space division system employing a material support linkage and connected to a structural channel system in accordance with the invention;

FIG. 53 is an exploded view of one section of the space division system with the material support linkage in accordance with the invention;

FIG. 53A is a front elevation view of two adjacent first side sections, showing a first support pole assembly, second support pole assembly and intermediate support rod assembly;

FIG. 53B is an overhead, plan view of the space division system illustrated in FIG. 53A;

FIG. 53C is a right-side elevation view of the space division system illustrated in FIG. 53A;

FIG. 53D is an enlarged view of an upper end of the second support pole assembly illustrated in FIG. 53A, taken within circle 53D illustrated in FIG. 53A;

FIG. 53E is an enlarged view of the interconnection of the material support linkage assembly with the second support pole assembly, as shown by circle 53E in the illustration of FIG. 53A;

FIG. 53F is an enlarged view of a lower end of the first support pole assembly at an interconnection with the lower material support linkage assembly, taken within circle 53F of FIG. 53A;

FIG. 53G is an enlarged view of the interconnection between the upper material support linkage assembly and the first support pole assembly, as shown within circle 53G illustrated in FIG. 53C;

FIG. 53H is an enlarged view of a lower end of the second support pole assembly at the interconnection with the lower material support linkage assembly, taken within circle 53H of the illustration in FIG. 53A;

FIG. 53I is an enlarged view of a lower end of a rod assembly and its interconnection to the lower material support linkage assembly, taken within circle 53I of the illustration in FIG. 53A;

FIG. 53J is an enlarged view of an upper end of a rod assembly and the interconnection with the upper material support linkage assembly, taken within circle 53J of the illustration in FIG. 53A;

FIG. 53K is a front elevation view of the second lower support pole illustrated in FIG. 53A;

FIG. 53L is a right-side elevation view of the second lower support pole illustrated in FIG. 53K;

FIG. 53M is an enlarged view of an upper end of the second lower support pole, taken within circle 53M of the illustration in FIG. 53K;

FIG. 53N is an enlarged view of the lower end of the second lower support pole assembly, taken within circle 53N of the illustration in FIG. 53L;

FIG. 53O is a front, elevation view of the first lower support pole illustrated in FIG. 53A;

FIG. 53P is a right-side elevation view of the first lower support pole illustrated in FIG. 53O;

FIG. 53Q is an enlarged view of the upper end of the first lower support pole, taken within circle 53Q of the illustration in FIG. 53O;

FIG. 53R is an enlarged and right-side view of the upper end of the first lower support pole, taken within circle 53R of FIG. 53P;

FIG. 54 is a side, elevation view of one adjustable link of the material support linkage in accordance with the invention;

FIG. 55 is a side, elevation view of a plurality of adjustable links of the material support linkage;

FIG. 56 is a plan view of a partial section of the adjustability mechanism of an adjustable link;

FIG. 57 is a top plan view of the entirety of one adjustable link;

FIG. 58 is a side, sectional view of the adjustable link shown in FIG. 57, taken along section lines 58-58 of FIG. 57;

FIG. 59 is an underside, plan view of the adjustable link shown in FIG. 57;

FIG. 60A is a rear, elevation view of the adjustable link shown in FIG. 59, taken along lines 60A-60A of FIG. 59;

FIG. 60B is a front, elevation view of the adjustable link shown in FIG. 59, taken along lines 60B-60B of FIG. 59;

FIG. 61A is a sectional view of a pair of adjustable links, with a first end optional support rod and support foot;

FIG. 61B is a sectional view of a pair of adjustable links, showing a second end optional support rod and support foot;

FIG. 61C is a sectional view of a pair of adjustable links, with a mid-position or variable position optional support rod and support foot;

FIG. 62A is a sectional view of a pair of adjacent, adjustable links, showing the capability of digital adjustment between positions;

FIG. 62B is a sectional view of one example of a given contour which may be achieved, utilizing the adjustability feature of a set of adjacent, adjustable links;

FIG. 63A is a perspective and partial view, showing the concept of utilizing a fabric panel zipper construction for releasably coupling together a spaced element comprising a pair of side sections;

FIG. 63B is somewhat similar to FIG. 63A, but shows the concept of releasably coupling together, through a zipper construction, a pair of adjacent side sections, located on one side of the space division system;

FIG. 64 is a sectional view, illustrating how a fabric side section may hook to a series of adjustable links, through the use of J channels;

FIG. 65 is an elevation view of the inside of a side section, showing top and bottom J channel hooking configurations;

FIG. 66A is a section view along the length of a spaced element, showing the adjustable links and configurations for fastening opposing side sections together;

FIG. 66B is an enlarged, plan view showing an end portion of a spaced element, taken within circle 66B of the illustration in FIG. 66A;

FIG. 67 is an elevation view of a support rail and a mounting bracket for the same;

FIG. 68 is a perspective view of the support bracket and mounting rail illustrated in FIG. 67;

FIG. 69 is an end view of a mounting bracket adapted for use with a structural channel system;

FIG. 70 is a perspective view of the mounting bracket illustrated in FIG. 69;

FIG. 71 is an elevation of what could be characterized as a conventional mounting bracket for the structural channel system.
FIG. 72 is a perspective view of the conventional mounting bracket illustrated in FIG. 71;

FIG. 73 illustrates a support rod connection to the top portion of the space division system;

FIG. 74 illustrates the concept that the space division system may be of variable height;

FIG. 75 is a perspective view of an illustration showing the use of a pair of space division systems in a “stacked” relationship;

FIG. 76 is a sectional end view of a set of spaced elements, showing an example of a void which may exist between a pair of opposing side sections, with the capability of incorporating or implementing electronics therein;

FIG. 77 is a perspective view of one example of the use of DC power being generated from an AC network and distributed among the spaced elements of the space division system; and

FIG. 78 is an example of the internal relationship between an electronic implementation, in the form of a speaker, and a pair of opposing side sections of the space division system.

DETAILED DESCRIPTION OF THE INVENTION

The principles of the invention are disclosed, by way of example, in a space division system 600, incorporating technology. The space division system 600 utilizes a series of movable and internally reconfigurable vertically disposed partitions for purposes of providing lighting aesthetics, function signaling, privacy, semi-private configurations and the like. In addition, the space division system 600 in accordance with the invention also provides a space division system which facilitates incorporation of various technologies. Space dividers and other aspects of the space division system 600 in accordance with the invention are capable of physical relocation, and comprise lightweight components. Rapid addition/deletion of joined space dividers is provided, through the use of quick-release components.

Still further, space division systems in accordance with the invention can comprise integration of solid state lighting (SSL). This lighting can be utilized for functions such as providing for color changes of space dividers themselves. Still further, lighting functions can provide for the signaling of interior or exterior circumstances. For example, lighting associated with the space dividers can be utilized to provide wayfinding. Signaling can also be utilized to indicate, for example, that a person is “in” within a particular working space.

Space division systems in accordance with the invention can also comprise integration and distribution of power. In particular, space division systems in accordance with the invention provide for DC power distribution.

With respect to specifics of space division systems in accordance with the invention, they can include channel voids within space dividers. These voids can be utilized to carry power lines, lighting, digital storage and other components.

Still further, space division systems in accordance with the invention provide for modification and reconfiguration of the appearance of space divider fabrics. Color change can be provided, for example, through the use of solid state lighting embedded within channel voids of the space dividers. In addition, appearance changes can be made to occur through the use of functional control of conventional lighting.

Space dividers employed in space division systems in accordance with the invention can also provide for acoustical ameliorations. For example, space divider fabrics can employ physical sound attenuation material. Also, components associated with the space division system can provide for functional control of sound management systems and the like. Further, a primary aspect of space division systems in accordance with the invention relates to the totality of the foregoing principles.

For purposes of describing the space division system 600 in accordance with the invention in detail, reference is first made to a space division system 100 as described and illustrated in FIGS. 1-51. This particular space division system 100 was previously disclosed in a co-pending international PCT application entitled ceiling system with technology, filed Sep. 4, 2003. The space division system 600 in accordance with the invention is described after the description of the space division system 100, and is illustrated in FIGS. 52-78.

Turning to FIG. 1, the particular example of a space division system 100 illustrated therein shows a space divider 102 vertically suspended from a rail system 104. The rail system 104 includes a rail 106 with a pair of hanger clips 108 which are releasably secured to the rail 106 and capable of being moved along a continuum of the length of the rail 106. Support rods 110 depend downwardly from the hanger clips 108 and are secured to the space divider 102. Preferably, the support rods 108 are adjustable in length so that the height of the space divider 102 may also be adjustable. Connection of the support rods 110 to the space divider 102 may be accomplished by any number of suitable means. For example, the lower terminating ends of the support rods 110 may be located within grommet holes (not shown) at the top portion of the space divider 102. Such grommet holes may be spaced apart in a manner so as to provide variation in the location of interconnections of the support rods 110 to the space divider 102.

As earlier stated herein, the hanger clips 108 can be characterized as “quick release” and “quick connect” elements. That is, the hanger clips 108 are advantageous for rapidly reconfiguring the physical locations of space dividers 102 relative to the rail system 104. General concepts associated with the rail system 104, and more specific configurations of elements such as the hanger clips 108, are disclosed in the commonly assigned U.S. Provisional Patent Application Ser. No. 60/408,149, entitled “Rail System” and filed Sep. 4, 2002.

The space divider 102 may include an upper structural batten 112. The upper structural batten 112 provides, in part, for “shape holding” of the space divider 102. Extending downwardly from the structural batten 112 is the main body 114 of the space divider 102. The main body 114 may be of a fabric which is substantially opaque, so as to generally provide a visual privacy curtain. Associated with the main body 114 is lighting technology, which may be in the form of solid state lighting (SSL) technology, such as LED lights. For example, embedded within the main body 114, in a manner so as to be visible to a person near the space divider 102, are a series of LED lights 116 arranged in a horizontal configuration. Further solid state lighting, which may also be in the form of LED lighting, is structured as arrow lighting 118 shown near the bottom of the main body 114. In emergency situations, the arrow lighting 118 may be activated (in any of a number of appropriate control arrangements) so as to acti-
vate all of the arrow lights 118 or, alternatively, the arrow lights 118 may be activated in a manner so that they are sequentially “pulsed” so as to create the effect of “pointing” in a particular direction to show an appropriate direction of egress in an emergency situation.

[0142] In addition to the concept of using arrow lighting 118, other types of functional signaling can be provided. For example, solid state lighting or other types of lighting could be utilized in combination with other elements so as to signal various other internal and external situations. For example, solid state lighting associated with the space dividers 102 could be utilized to indicate if an individual is “in” a particular workspace or, alternatively, is absent. Numerous other types of signaling could be utilized with the solid state lighting associated with the space dividers 102.

[0143] The space divider 102 also includes a lower hemmed section 120 having a weighted insert as described in subsequent paragraphs herein with respect to other drawings. The weighted insert within the lower hemmed section 120 may also be utilized for purposes of “shape holding.” With respect to the rail 106, hanger clips 108 and support rods 110, various types of configurations may be utilized. One type of configuration is disclosed in the commonly assigned U.S. Provisional Patent Application Ser. No. 60/408,149, entitled “Rail System” and filed on Sep. 4, 2002.

[0144] FIG. 2 illustrates a plan view of an office environment showing various configurations of space dividers of a space division system according to the invention, in differing configurations. For example, FIG. 2 illustrates use of a wall curtain 130 having somewhat of a “hooked” configuration. A further space divider 132 is illustrated as showing a series of “S-shaped” configurations, which may be utilized to provide a series of computer workstations or the like. Conference tables 134 are illustrated as being somewhat enclosed through the use of the space dividers 130, 132.

[0145] In addition to the foregoing, space divider 136 is shown as primarily enclosing a privacy section 138, which may be utilized for telephone calls or the like. Other areas may be partitioned or otherwise have space dividers of the space division system in a manner so as to provide aesthetics, such as space dividers 140 and 142. The various configurations of the space dividers illustrated in FIG. 2 can provide for various types of spaces. With the interconnection of space dividers such as 130, 132 and 140, 142, the interconnections can be provided through the use of splines. The spline interconnections are illustrated within the drawings. With the spline interconnections, reconfigurations of the various space dividers is not limited to movement along specific line segments. Instead, with the use of the splines, movement can occur with respect to the space dividers and the configurations to configurations having a curve of any reasonable radius.

[0146] FIG. 3 illustrates a side-elevation view of a space divider in accordance with the invention. FIG. 4 illustrates a partial sectional end view of the same. With reference to FIGS. 3 and 4, the space divider 150 may be comprised of a translucent and stretchable material. FIG. 4 illustrates how the material 152 may be woven into the wall configuration. The space divider 150 may also have a power batten 154 positioned at the top thereof, for purposes of carrying power such as low voltage DC power. The power batten 154 may provide power to a DC power cable 156 or, alternatively, an AC power cable 158. The DC power cable 156 may carry DC low voltage power and is accessible through power batten openings 160. The power batten openings 160 would be accessible to internal linear voids existing within the three-dimensional knitting of the main body 150. The linear voids are illustrated as voids 162 in FIGS. 3 and 4.

[0147] FIG. 5 illustrates another space divider 170 which may be formed of a woven fabric material. For example, one type of woven material which may be utilized is commonly referred to in the industry as “cattle mattress” material. The cattle mattress material of the space divider 170 provides linearly directed pockets 172 which may be segmented by the use of brackets 174, as illustrated in FIG. 6.

[0148] FIG. 7 is a perspective view of two curved space dividers, forming a space division system 180. The space division system 180 includes a first space divider 182 and a second space divider 184. In general, FIG. 7 illustrates a structural configuration which may be achieved with respect to aesthetic curvature, through the use of the space dividers 182, 184. Also, FIG. 7 illustrates use of not only the rails 106, but also the use of a cross rail 186. The configuration of a cross rail 186, with the use of vertically disposed partitions, is described in the commonly assigned U.S. Provisional Patent Application Ser. No. 60/408,149, entitled “Rail System” and filed on Sep. 4, 2002.

[0149] FIG. 8 illustrates a sectional end view of the space divider 184. This view shows the structural batten 112 at the top end thereof, with the fabric extending downwardly therefrom. Linear or substantially horizontal voids 188 are provided spaced-apart intervals downwardly along the space divider 184.

[0150] The space divider 184 terminates at its lower portion with the lower hem 120. The lower hem 120 is shown having a weighted insert 190. The weighted insert 190 is utilized to maintain the space divider 184 in a stable position. That is, the weighted insert 190 provides for “shape holding” for the space dividers of the space division system 100. In a particular example illustrated in FIG. 8, the weighted insert 190 may be a tubular section 192 fitted within the hem 120, and filled with material such as sand.

[0151] FIG. 8A is similar to FIG. 8, but shows the lower hem 120 as capturing a tubular insert 192. The tubular insert 192 may be a flexible sheath 194 consisting of rubber or the like. The sheath 194 may be of relatively substantial weight and of itself or, alternatively, may be weighted by the use of sand or other materials carried within the sheath 194. The weighted insert 192 can include an end tab 196 which may be interconnected to a cooperating recess or similar connecting means in the weighted insert 192 associated with an adjacent space divider 184. In this manner, the weighted inserts of adjacent space dividers may be interconnected together.

[0152] FIG. 9 is a sectional end view (taken along section lines 9-9 of FIG. 7) showing an end portion of the space divider 184. In this particular configuration, a power batten 200 extends downwardly so as to form an end hem of the space divider 184. A low voltage DC power cable 202 may be extended downwardly through the power batten 200. In addition, it is also possible to extend a communication cable 204 through the batten 200. The batten 200 is formed by taking the space divider 184 and turning it rearward upon itself, and then connecting the end of the space divider 206 to another portion of the space divider 184 through the use of a spring clip 208 or a similar releasable securing means.

[0153] FIG. 10 illustrates an interconnection between the space divider 182 and 184 which may be employed in accordance with the invention. In this particular embodiment, a power batten 210 (having communication cables 204) is
formed at the intersection of the space dividers 182 and 184. The space dividers 182 and 184 are releasably coupled together through the use of a pair of spring clips 208.

[0154] In accordance with the foregoing, the space division system 100 in accordance with the invention provides for the rapid addition and deletion of space dividers. In addition, the elements of the space division system 100 exhibit internal stretch characteristics, with respect to space divider surfaces, battens and frames. These internal stretch characteristics provide for a continuum of configurations, with the spline interconnections providing for curvature of any reasonable arcs.

[0155] FIG. 11 is a close up section of the end portion of the space divider 184, similar in form to FIG. 9. However, FIG. 11 further illustrates the use of 3D translucent material for the space divider 184. Further, FIG. 11 illustrates communication cables 212 which may extend through a pre-woven pocket 214 of the translucent space divider 184.

[0156] FIG. 12 illustrates a “close up” view of the intersection between the space dividers 182, 184. FIG. 12 is a view similar in scope to FIG. 10, but further illustrates power/communication cables 216 extending through pre-woven pockets 218 of the space dividers 182, 184.

[0157] FIG. 13 is a close up section view of an end portion of the space divider 184 (similar to FIG. 11), but illustrating the space divider 184 as comprising a woven fabric material 220. Various types of woven materials may be utilized as material 220. For example, in the particular embodiment described and illustrated herein, the woven material 220 may be a material which is characterized as “cattle mattress” material. FIG. 14 is a close up section similar in scope to the close up section illustrated in FIG. 12, but showing the two space dividers 182, 184 as employing cattle mattress material 220.

[0158] FIG. 15 is an elevational view of space dividers 230. More specifically, the space dividers 230 include a series of internal linear voids 232 through which linear LED lighting strips may be inserted. Referring to both FIGS. 15 and 16, such an LED lighting strip is illustrated in FIG. 16 as LED strip 234. LED strip 234 will have a sequential series of LED lights 236 extending along the lighting strip 234. The lighting strip 234 will be positioned within the linear void 232. For purposes of carrying other elements, such as power cables or communication cables, additional linear voids, such as hollowed area 238 and 240, may also be horizontally located within the space dividers 230. FIG. 15 also illustrates the use of a series of LED power supplies 242 which may be connected to LED power lines 234. In turn, the LED power lines 234 may be interconnected in any appropriate manner to the LED lighting strips 236. Further, additional power may be provided, such as with the utilization of a 12-volt DC utility power supply line 246.

[0159] The particular LED lighting strips 234 may comprise, for example, yellow linear flex side LED lighting strips, having a configuration of approximately 2 inches by 24 feet. Other interconnections may also be employed with the space dividers 230, such as Internet connections and the like. FIG. 17 is a side elevational view of a similar set of space dividers 250. The sections 250 are similar to the sections 230 previously described with respect to FIG. 15. In addition, these sections carry LED power supplies 242 and LED power lines 244, in addition to a DC power line 246. However, as illustrated in FIG. 18, the LED lighting strips 260 are turned in a different direction from the LED lighting strip 234 illustrated in FIG. 16. In this manner, the actual light intensity and light diffusion at the opposing surfaces of the space dividers 250 will be different than that of the sections 230. Further, FIGS. 17 and 18 illustrate the use of two LED lighting strips 260.

[0160] FIG. 19 is a further embodiment of a pair of space dividers 270, with FIG. 19 showing a side elevational view thereof. With respect to FIGS. 19 and 20, a series of LED power supplies 242 are shown, interconnected to LED power lines 244. Correspondingly, a DC power line 246 is also illustrated. With the space dividers 270, linear voids 272 are provided, one of which carries an LED lighting strip 274 having the substantially “flat” configuration illustrated in FIG. 20. In this particular configuration, a differing light intensity and light dispersion will be seen on the left side surface of the space divider 270 (as viewed in FIG. 20), while a relatively opaque view will be found from the right side of the space divider 270 (again as viewed in FIG. 20).

[0161] FIGS. 21, 22 and 23 illustrate similar space dividers utilizing LED internal lighting technology. FIG. 21 illustrates space dividers 290, having linear voids 292 positioned at the lower portion thereof. As illustrated in FIG. 22, each of the linear voids 292 carries a flat-configured LED lighting strip 296 facing toward the left side of the space divider 290 illustrated in FIG. 22. Alternatively, FIG. 23 is similar in form to FIG. 22, and illustrates the upper LED flat-configured lighting strip 298 as facing to the right side of the space divider 290, while the lower LED flat-configured lighting strip 298 faces toward the left side of the space divider 290. Again, the particular light intensity, diffusion and color “wash” which will be associated with the space dividers 290 will be dependent upon the spacing and the configuration of the LED lighting strips. It should be understood that the lighting strip configurations described herein are merely examples of those which may be utilized with a space division system in accordance with the invention. Numerous other LED lighting strip configurations could be utilized, without departing from the spirit and scope of the novel concepts of the invention.

[0162] FIG. 24 illustrates a pair of space dividers 300 having a linear or horizontal void 302 wherein an LED lighting strip 304 is embedded. The LED lighting strip 304 includes a series of arrows which can be utilized for emergency directional lighting, and may be sequentially “pulsed” so as to illustrate a direction of egress for emergency evacuation. For purposes of emergency directional lighting, various additional electrical equipment may be required. For example, it is not uncommon for electrical and other building codes and regulations to require the use of separate power sources for emergency lighting. In such event, such power sources may be required to be electrically interconnected with the LED lighting strip 304. Also, the lighted arrows of the LED lighting strip 304 may be utilized for purposes other than emergencies. As an example, the arrows of the LED lighting strip 304 may be utilized to provide “wayfinding” for purposes of directing visitors to the commercial interior to appropriate locations within the interior, as well as for purposes of emergencies. Along with other appropriate power and lighting equipment, the arrows of the LED lighting strip 304 may be utilized, for example, to direct visitors in a library to appropriate book classification sections. Numerous other wayfinding uses may also employ the use of arrows or similar directional indicators of the LED lighting strip 304. For example, and as earlier mentioned, lighting may be utilized for indication of external and internal situations. For example, lighting may be associated with the space dividers in a manner so as to indicate whether an individual is “in” a particular workspace.
FIGS. 25 and 26 illustrate a pair of space dividers 310, with LED lighting technology utilized externally of the space dividers 310. More specifically, the space dividers 310 include a curtain 314 mounted from the top portion of the space divider 310. Depending forwardly and horizontally from the space dividers 310 is an LED lighting strip support 316, which may be appropriately secured to a linear void 312 of the space dividers 310. Positioned downwardly from the support 316 is a series of LED lights. The LED lights may be of appropriate colors, and will provide what may be characterized as an external “wash” and a color “wash” over the lower portion of the side surfaces of the space dividers 310, below the curtain 314. This color wash can be modified in intensity and with respect to diffusion dependent upon the intensity and color of the LED lights 318, and of particular materials from which the space dividers 310 are constructed.

FIG. 27 illustrates a pair of space dividers 320 showing a low voltage DC power line 328, communications cabling 326, AC power line 322 and AC power line 324. The AC power line 324 terminates in a pair of electrical receptacles 330. A computer 332 may be energized through the electrical receptacles 330. Data and communication signals may be transmitted from the computer 332 through a communication signals junction box or modem 334, and outwardly through the communications cabling 326. In this manner, the space dividers 320 provide power and networking technology. FIG. 28 is a side elevational view of space dividers 340, similar in structure to the space dividers 320 illustrated in FIG. 27. In this particular instance, the space dividers 340 are illustrated showing use of wall-connected task lighting technology. The configuration employs a task light 342 illustrated in FIGS. 28 and 29. The task light 342 utilizes low voltage DC power and LED lighting technology. As illustrated in FIGS. 28 and 29, the LED task light 342 includes a rectangular LED marker 344 at the terminus of the task light 342. Extending downwardly from the marker 344 is a rigid foam core 346. The rigid foam core 346 is adjacent to a flexible joint 348. A fabric cover 350 extends downwardly and angularly from the flexible joint 348. The fabric cover 350 is interconnected to an appropriate securing bracket 352, which is secured to the space divider 340 by appropriate means. For example, Velcro or a similar securing means could be employed. The task light 342 may be utilized to provide appropriate light for use of a computer screen 354.

In addition to the foregoing, the space dividers and associated channel voids can be utilized with data storage technology. For example, the computer 332 or other types of computerized or communications equipment could be releasably attached to a data storage device embedded within voids of the space dividers. These data storage devices could be in the form of disks or similar devices. Also, for example, data storage and programming devices such as microprocessors could also be embedded within voids of the space dividers for releasable interconnection to other types of equipment, such as sound management technology and the like. With respect to all the foregoing, the space division system 100 in accordance with the invention provides for actual data storage embodied and embedded within the space division system itself. In this manner, the space dividers themselves are not merely fabrics within frames having buttons and the like, but are elements which take advantage of today’s miniaturization and advancements in technology, so as to provide data storage, access to programmable devices and the like.

FIG. 30 illustrates a curved configuration of a space divider 360 showing the use of the task light 342 therewith. FIG. 31 is an elevational view of a pair of space dividers 370, showing the use of DC low voltage technologies with a pair of task lights 342. FIG. 31 further shows the energizing of a coffee maker 343, through the power supplied to the space dividers 370. FIG. 32 illustrates another pair of space dividers 380, showing the space dividers 380 in use in an office environment with technologies. For example, this office environment may include a telephone 382, MP3 player 384, laptop 386 and fan 388. FIG. 33 illustrates another pair of space dividers 390, showing use with technology which may be associated with a temporary work or gathering space. For example, the configuration illustrated in FIG. 33 includes a phone 382, a set of wireless headphones 384, teleconferencing screen 386 and various other accessories.

FIG. 34 is substantially similar to FIG. 2, but further illustrates the use of a projector 400 in use with a screen 402 secured to the space divider 130. The foregoing drawings illustrate interconnections of various types of technological and other functional accessories through the space dividers. Further, the drawings illustrate the use of velcro clips at attachment points. As earlier stated, data storage devices and switches can also be employed with the space dividers.

Still further, other types of equipment may be utilized. For example, both wired and wireless headphones may be employed and energized through the DC power distribution systems. Still further, projection equipment may be utilized, with projection screens releasably attached to fabrics of the space dividers. This was illustrated with respect to projector screen 402, coupled to the space divider 130. Still further, however, projection may occur upon fabric surfaces of the space dividers themselves. This can be provided through the use of monofilaments.

FIGS. 35, 36 and 37 illustrate alternative embodiments and configurations of space dividers 410, 420 and 430, respectively, and illustrate various plan views of these space dividers so as to provide visual privacy. These space dividers may be in the form of what is characterized as “technology curtains,” and create flexible spaces for individual and small group uses. In addition, the enclosures provided by these space dividers exhibit daily flexibility for project teams. FIGS. 38 and 39 show other configurations of the technology curtains, identified as technology curtains 432 and 434. These technology curtains can be characterized as being configured in a “flutter” form configuration. FIGS. 38 and 39 show two alternative embodiments of the “flutter” form configuration. With these configurations of the technology curtains, relatively more efficient place making is provided. In addition, these configurations essentially maximize characteristics which tend to be unique to “hung” fabric. These arrangements also afford a greater variety of space division, and also move or a greater spatial “sense.” In addition, these “flutter” form configurations create more receptive spaces than what are characterized as “booth” walls. The “flutter” form configurations also provide relatively greater flexible niche scale. In general, the embodiments of FIGS. 35, 36 and 37 show movement from “shared” to “separate” configurations. The enclosures formed by the space dividers within these drawings provide for substantial flexibility for project teams and the like. Still further, the configurations in FIGS. 38 and 39 provide for individuals’ space along edges, in addition to collective action. That is, adjacency is provided, but with relatively more privacy.
FIGS. 40 and 41 illustrate technology curtain configurations 436 and 438. These configurations may be characterized as “quadruple” configurations. In these illustrations, the spaces shown move collectively to a less flexible, central passageway which grows so as to accommodate group work. The configurations comprise technology curtains which would provide both visual privacy and sound absorption. Advantages associated with “quadruple” configurations relate to the responsiveness to fluid conditions of collaborative work practices. In addition, these configurations provide daily flexibility for project teams, and can be grouped as “sub-centers” around what may be characterized as a “silent center.”

FIGS. 42, 43 and 44 illustrate the use of technology curtains 440, 442 and 444, respectively, and exemplify what can be characterized as “triplex” configurations. These technology curtain configurations provide both visual privacy and sound absorption. Benefits include responsiveness to fluid conditions of collaborative work practices, in addition to daily flexibility for project teams. In addition, these triplex configurations can be grouped as “sub-centers” around a silent center. More specifically, FIG. 42 illustrates a configuration having three spaces. Correspondingly, FIG. 44 illustrates a configuration with two spaces, while FIG. 43 illustrates a single space configuration.

FIG. 45 illustrates the actual use of a translucent space divider 450.

As earlier referenced herein, the space division system 100 with technology provides a means for facilitating control and reconfiguration of control relationships among various functional components which may be utilized with the space division system 100. For purposes of describing the concept of establishing controlling relationships among various controlled and controlling components which may be associated with the space division system 100, reference is made to the commonly assigned U.S. Provisional Patent Application Ser. No. 60/374,012, entitled “Switching/Lighting Correlation System” and filed on Apr. 19, 2002. The contents of the aforementioned patent application are hereby incorporated by reference herein.

In this regard, it is relatively apparent that it would be favorable to establish control relationships among switches and lights, and have the capability of reconfiguring the same. Other control relationships may also be worthwhile. For example, FIG. 46 illustrates a user employing a control wand 460 (to be described in subsequent paragraphs herein) for purposes of establishing control of an LED lighting strip 462. FIG. 46 also illustrates the location of a wall-attached task light 464. These elements are associated with a space divider 466. FIG. 47 is similar to FIG. 46, but further illustrates the user employing the control wand 460 for purposes of establishing control of the task light 464. An example of the control wand 460 is illustrated in FIGS. 48, 49 and 50.

With reference thereto, the control wand 460 may be of an elongated configuration. At one end of the control wand 460 is a light source 470 which, preferably, would generate a substantially collimated beam of light. In addition to light source 470, the control wand 460 may also include an infrared (IR) emitter 472, for transmitting infrared transmission signals to corresponding IR receivers associated with the LED lights 462 or task light 464, in addition to switches or the like which may control these functional accessories.

The control wand 460 may also include a trigger 474, for purposes of initiating transmission of IR signals. Still further, the wand 460 may include mode select switches such as mode select switch 476 and mode select switch 478. These mode select switches may be utilized to allow manual selection of particular commands which may be generated using the wand 460. The control wand 460 may also utilize controllers (not shown) or similar computerized devices for purposes of providing electronics within the wand 460 for use with the trigger 474, mode select switches 476, 478, light source 470 and the IR emitter 472. As earlier mentioned, an example of the use of such a wand, with the attendant commands which may be generated using the same, is described in the commonly assigned U.S. Provisional Patent Application Ser. No. 60/374,012, entitled “Switching/Lighting Correlation System” and filed on Apr. 19, 2002.

Referring back to FIGS. 46 and 47, the user may employ the wand 460 to transmit signals to controllers (not shown) associated with the LED lights 462 and task light 464. The capability of essentially “programming” controlled relationships among the various accessories associated with the space division system 100 requires the capability of transmitting and receiving communication signals among the various functional accessories. In this regard, infrastructure systems may be employed. An example of such an infrastructure system which may be employed with the space division system 100 in accordance with the invention is described in detail in the commonly assigned U.S. Provisional Patent Application Ser. No. 60/408,149, entitled “Rail System” and filed on Sep. 4, 2002.

FIG. 51 is a perspective view of a particular configuration utilizing space divider 500 in a curved configuration, with task lights 502. Such an arrangement could be utilized within a library, study hall or restaurant configuration. Also, mention should be made that space divider 500, as well as other space divider configurations illustrated and described herein, may be utilized with various types of ceiling structures. One such ceiling structure is illustrated in the commonly assigned U.S. Design Patent Application Serial No. 29/166,803, entitled “Design for Articulating Ceiling” and filed Sep. 4, 2002.

Various types of appliances and technologies may be utilized with the space dividers of the space division system 100, in addition to those that have been expressly described in detail herein. For example, sound apparatus such as speakers and the like may be integrated into the various space dividers of the space division system 100. Such speakers may be energized through power and communication sources described herein, or through other energizing means, including batteries and the like. Still further, the speakers could be selectively enabled as desired, and controlled with the control wand 460 and control processes described earlier herein.

Still further, noise masking processes could be employed with the use of these speakers, in addition to general acoustical control arrangements. Still further, the noise masking arrangements employing the speakers could be integrated within a virtual structure associated with the space division system 100. In general, various types of speakers, noise masking, acoustical control and other equipment and processes could be employed with the technologies of the space division system 100, and powered with the method and apparatus described herein, as well as with other energizing arrangements (e.g. batteries).

Still further, the space dividers of the space division system 100 may have application in situations which require
the employment of security measures. In this regard, it may be advantageous to construct space dividers of the space division systems with materials having a substantial capability of resisting penetration. An example of one such material is known as Kevlar® brand fiber, with the term Kevlar® being a registered trademark of E.I. duPont de Nemours and Company. Kevlar® brand fiber is p-phenylene terephthalamide. Kevlar® brand fiber combines relatively high strength with light weight. Kevlar® brand fiber is within a family of nylon fibers known as Aramids. Specifically, and is within a polyamide, with amide groups attached at carbons 1 and 4. For purposes of security, various of the space dividers of the space division system 100 may be constructed of Kevlar® brand fiber.

Still further, will respect to security and safety, the space dividers of the space division system 100 may be constructed of fire resistant or fire proof materials. One such material which also falls within the family of Aramids is known as Nomex® brand fiber. The term Nomex® is also a trademark of E.I. duPont de Nemours and Company. Nomex® brand fiber is commonly utilized for purposes of making fire proof clothing. Unlike Kevlar® brand fiber, Nomex® brand fiber has amide groups attached at carbons 1 and 3. It is not uncommon to construct materials which are blends of both Nomex® and Kevlar® brand fibers. It may therefore be advantageous to construct the space dividers of the space division system 100 with materials employing Nomex® brand fiber or other materials having fire proof properties, in addition to Kevlar® brand fiber or other materials which substantially resist penetration.

Another configuration of the space division system 100 may also be important with regard to security and safety. Specifically, it may be advantageous to incorporate means in the space division system 100 for releasably securing space dividers and other elements of the space division system 100 to a floor structure. Various types of securing means could be employed with the space dividers, lower battens and the like. However, it would be preferable to insure that the means for securing elements of the space division system 100 to the floor structure still permit release of these elements from the floor structure without significant effort.

Turning to other apparatus and concepts which may be employed with a space division system in accordance with the invention, the lighting configurations described herein (such as LED lighting strip 462, task light 464 and the like) may employ various types of controlling apparatus in the form of enabling switches for controlling the state of the lighting elements or other electrical apparatus, appliances, computerized equipment and the like. In this regard, various types of switches may be employed. These switches may be in the form of conventional switches having differing spatial positions for “on” and “off” states. However, other types of switches may also be employed. For example, the space division system 100 in accordance with the invention may employ optical switches for controlling lighting elements, electrical appliances and the like. With respect to use of the control wand 460 previously described herein, the switches may be associated with sensors which can detect spatial signals transmitted from the wand 460. Further, physically operable switches such as pressure switches may also be employed. Still further, various types of motion sensing devices may be employed to enable and disable switches and associated equipment. These and other types of switches may also be employed with the use of radio frequency identification (“RFID”) systems, whereby, for example, an individual entering a room with a specific RFID badge may cause switches and their associated sensors to identify the individual and configure lighting elements and other equipment associated with the space division system 100 to specific states. Still further, all of these types of switches and other controlling devices may be communicatively coupled to a power and communications network with the space division system 100. Such a network is generally described in the commonly assigned U.S. Provisional Patent Application Ser. No. 60/408,149, entitled “Rail System” and filed Sep. 4, 2002.

In summary, a space division system 100 has been disclosed which provides for movable and internally reconfigurable space dividers, incorporates various technologies and is not limited in size or expansion capability. The system is internally reconfigurable, light weight and employs quick-release elements. In this regard, joined space dividers can be rapidly added and deleted, and the output of splines provides movement from line segment configurations to configurations having a curve of any radius.

In the same regard, internal stretch characteristics are exhibited by space divider surfaces, battens and frames. Digital storage is also provided within voids of fabrics associated with the space dividers. Still further, digital programming and switching is also provided. In this manner, space division systems in accordance with the invention harness the effect of fiber or other elements through the embedding and integration of electronic components. In addition, solid state lighting is integrated within the system, having capabilities such as changing color appearances of space dividers and the like. In addition, signaling of interior and exterior circumstances is provided. In the same regard, space division systems in accordance with the invention incorporate integration and distribution of power, particularly DC power and the flexible use of 12-volt applications.

With regard to structure, channel voids are provided within space dividers at differing heights. Space divider fabrics can be modified in appearance, such as providing color changes using solid state lighting. Color appearance can be also modified through the functional control of conventional lighting. Space division systems in accordance with the invention can also exhibit acoustical ameliorations, through the use of physical sound attenuation material, functional control of sound management systems and the like.

As previously described, the space division system 100 was generally disclosed in an International PCT Patent Application entitled CEILING SYSTEM WITH TECHNOLOGY, and filed Sep. 4, 2003. The system of primary interest herein, in accordance with the invention, is referred to as the space divider system 600, illustrated in FIGS. 52-78.

The space divider system 600 may be used with a structural channel system 606. A structural channel system which may be utilized as structural channel system 606 is disclosed in a co-pending United States Provisional patent application entitled “POWER AND COMMUNICATIONS DISTRIBUTION USING A STRUCTURAL CHANNEL SYSTEM” and filed Aug. 5, 2004. The disclosure of the aforementioned patent application is incorporated by reference herein. This application will be referred to herein as the “channel system application.” Also, with respect to a particular support rail described subsequently herein, such a support rail is disclosed in detail in a co-pending United States Provisional patent application entitled “VISUAL SHIELDS
WITH TECHNOLOGY INCLUDING LED LADDER, NETWORK CONNECTIONS AND CONCERTINA EFFECTS” and filed Aug. 31, 2004. This application is incorporated by reference herein and will subsequently be described herein as the “visual shield application.”

[0189] With respect to the space division system 600 as subsequently described herein in accordance with the invention, the system 600 is advantageous with respect to ease of use. Material support linkage assemblies 610 as described herein allow the system 600 to be shaped in a desired form, and not in a predetermined shape. Spaced elements 602 associated therewith can be reshaped into various forms, and can be free-standing. Zipper connections allow for side sections 604 to be attached to one another on both sides of one length of the system, or in a contiguous manner to adjacent side sections 604 on the same side, thereby providing greater flexibility in space management. The zipper connections provide for universal attachment, and thus do not require different attachment methods upon reconfiguration. Vertical rods, such as the support pole assemblies 617 within the system 600, provide structural support. However, the pole assemblies and other supporting elements are relatively light, compared to traditional materials such as drywall. Threaded end rods can provide further structural support, as they are attached to elements of the structural channel system 606. These can be reoriented easily by attaching connecting clamps at different locations along the structural channel system 606.

[0190] Also, although the space divider system 600 can be utilized in combination with the structural channel system 606, it can also be used with other structures. Again, attachments such as threaded rods, cables or clamps can be utilized. In addition, floor supports may be utilized, which can be adjustable so as to compensate for uneven floors. Still further, support rods can be “keyed,” so that they can be readily assembled, but “locked” into position at the time of installation.

[0191] With respect to aesthetics, the side sections 604 can be replaced at will, and are interchangeable, allowing for different colors on each side, if desired. In this manner, an “open” system is provided. That is, the size of the space division system 600 can be increased or reduced, at will by the addition or deletion of spaced elements 602. Still further, various types of materials may be utilized for the side sections 604. For example, fiberglass covers may be utilized. If desired, such covers (and covers constructed of other materials) that utilize J channels and appropriate hooks. With the use of these elements, a continuum appearance can be provided, with minimal aesthetic disruption from seams and the like. The J channel cover attachments can be tensioned, in conjunction with torsion support provided by the vertical rods. This eliminates a “bunching” condition that typically occurs on the inner curve of curvilinear fabric wall structures. Further, various cover materials can be employed, so as to provide varying aesthetic looks, such as opaque, translucent, and the like.

[0192] Still further, the cover materials comprising the side sections 604 can provide functions other than coverings and aesthetics. For example, the side sections 604 can comprise cover materials that are appropriate for use as projection screens. Also, the surfaces can be such that lighting can change the appearance of the space. Still further, the side sections 604 can be constructed of varying heights, so as to meet the requirements of a particular space. In addition, it may be possible to stack space divider systems.

[0193] Still further, the use of the side sections 604 with the supporting assemblies and material support linkage assemblies can provide, if desired, for a continuous inner channel between opposing side sections 604. These channels can be utilized for various technologies. For example, with the cover materials of the side sections 604 exhibiting at least some translucency, lighting assemblies may be incorporated within the spatial areas between the side sections 604. Also, other equipment, such as acoustical speakers, may be attached to the side sections 604, with the second 604 cut at will for purposes of placement of the speakers. Cabling can be routed essentially anywhere within the channels between the side sections. Switches can also be placed and attached as desired. In addition, it may be possible to employ digital connections (e.g. 100 watt, class 2) within the space divider system 600, utilizing transformers connected to the structural channel system 606. In this manner, power can be provided for devices such as laptop computers, wayfinding features and the like. Such connections and adaptations may be undertaken by lay persons, and may not require an electrician.

[0194] With respect to economics, the space divider system 600 can be shipped in a manner so as to reduce shipping costs considerably, relative to shipping costs for conventional building wall materials. Also, the space divider system 600 can be essentially “rolled up” and stored when not in use, in a manner so as to require minimal space. Further, the elements of the space divider system 600, including side sections 604, can be reused. In contrast, demolition is sometimes required in conventional building instruction. The reuse of the elements of the space divider system 600 therefore reduces landfill costs versus conventional materials.

[0195] With these concepts in mind, reference is first made to FIG. 52, illustrating the space divider system 600 utilized with a structural channel system 606. Details regarding the structural channel system 606 can be found in the channel system application. The space divider system 600 is essentially “hung” from the channel system 606. Only a relatively small number of elements associated with the structural channel system 606 are illustrated in FIG. 52. Specifically, FIG. 52 illustrates a main structural channel rail 607. The structural channel rail 607 is also illustrated in a sectional, end view in FIG. 69. As shown in FIGS. 52 and 69, the main structural channel rail 607 includes a pair of side covers 638 surrounding the opposing lateral sides of the main structural channel rail 607. The side covers 638 enclose the main body of the structural channel rail 607, including two opposing side panels 640 (primarily shown in FIG. 69). The structural channel rail 640 also includes an upper portion 642. The main body of the structural channel rail 607 may be supported from a ceiling or other overhead structure (such as a building’s I-beams and the like) through support rods 644. The support rods 644 are coupled to the main structural channel rail 607 through suspension bracket assemblies 656. The particular configuration of these suspension bracket assemblies 656 and the operation thereof are described in detail in the channel system application.

[0196] Carried within the structural channel rail 607 are what can be characterized as modular plug assemblies 646. These modular plug assemblies 646 can be utilized to carry AC building power to various locations and equipment which may be associated with the space division system 600. In addition, the modular plug assemblies 646 can also be utilized
to transmit communication signals throughout a digital network which may be associated with the space division system 600. The signals can be utilized to control relationships among various application devices, such as switches, lights, projection screens, sound equipment and others. The modular plug assembly 646 and the concepts associated with carrying AC building power and communication signals are described in detail in the channel system application.

For purposes of example, FIGS. 52 and 69 also show other functional elements of the structural channel system 606. For example, an elongated wireway 648 is illustrated as being mounted above the structural channel rail 607. The wireway 648 may be an electrically isolating component for carrying relatively high voltage wires 650. FIGS. 52 and 69 also illustrate a cableway 652, mounted above the rail 607 and laterally of the wireway 648. The cableway 652 may have a structure similar to the wireway 648, but may not necessarily have substantial electrical isolating properties, and may be used for carrying digital and other low voltage cables 654. The wireway 648 and cableway 652 are also described in the channel system application, along with details associated with their interconnections to the suspension bracket assembly 656 and the rail 607. In addition to the main structural channel rail 607, the structural channel system 606 also includes other overhead supporting elements, such as the support rails 608. The support rails 608 are illustrated in FIG. 52, and can be interconnected to the structural channel rail 607 by any suitable means. One of the support rails 608 is illustrated in greater detail in FIGS. 67 and 68. Also, elements corresponding to the support rail 608 are described in detail in the visual shield application.

Although a particular structural channel system 606 is shown herein as being utilized with the space division system 600, it should be emphasized that concepts associated with the space division system 600 in accordance with the invention (particularly with respect to the material support linkages described herein) are not limited to use with the structural channel system 606. That is, the space division system 600 in accordance with the invention may be utilized with other types of supporting systems. In fact, various configurations of the space division system 600 in accordance with the invention may be utilized in a “free standing” mode.

The embodiment of the invention comprising the space divider system 600 will now be described in greater detail. The space divider system 600, as shown in FIGS. 52 and 53, includes a series of spaced elements 602. The spaced elements 602 essentially comprise opposing fabric or similar covers, characterized herein as side sections 604. The side sections 604 can be characterized as comprising a first side section 603 and an opposing second side section 605. At the top and bottom portions of the side sections 604 are material support linkage assemblies 610. The material support linkage assemblies 610 are specifically shown in FIG. 53, and will be described in greater detail in subsequent paragraphs herein with respect to other illustrations. The material support linkage assemblies 610 form a principal basis for the invention. As further shown in FIG. 53, the material support linkage assemblies 610 utilized with the space division system 600 include a lower material support linkage assembly 612 positioned near the bottom of the side sections 604 (and therebetween), and an upper material support linkage assembly 614 positioned adjacent the upper edges of the side sections 604. The material support linkage assemblies 610, as also generally shown in FIG. 53, are formed through the use of sets of adjustable links 616. These adjustable links 616 will be described in greater detail, with respect to other illustrations.

The support pole assemblies 617 will now be described, primarily with respect to FIGS. 53-53R. As shown in FIGS. 53 and 53A, the space division system 600 includes what can be characterized as the second support pole assembly 620. This assembly will be described first, since it represents the “left-most” assembly in FIG. 53A, and the remaining support pole assemblies will be described as shown in FIG. 53A from left to right. It should be noted at this time that the specific embodiment of the space division system 600 as illustrated in FIG. 53 is slightly different than the view of the space division system 600 illustrated in FIG. 52. That is, in FIG. 52, first and second support pole assemblies 618, 629, respectively, at one portion of the system 600 are illustrated as being connected at the upper portions thereof to the main structural channel rails 607. For this connection, a universal channel connector 894 is utilized. This channel connector will be subsequently described herein with respect to FIGS. 69 and 70. As an alternative, FIG. 53 (and FIGS. 53A-53R) illustrate a slightly different configuration, where the particular spaced elements 602 shown therein comprise two in number and utilize a first support pole assembly 618, second support pole assembly 620 and one intermediate support pole assembly 622. Also, FIG. 53A illustrates the use of rod assemblies 625. Again, this is somewhat of a different configuration in that illustrated in FIG. 52, and is meant to illustrate the concept that various configurations of the spaced elements 602 can be utilized to form the space division system 600 in accordance with the invention.

Again referring to FIG. 53A and the second support pole assembly 620 shown on the far left side thereof, the support pole assembly 620 extends upwardly and terminates in what can be characterized as an upper support tube assembly 658. The upper support tube assembly 658 is utilized to directly support the second support pole assembly 620 directly from any supporting structure associated with the structural channel system 606. Details regarding the upper portion of the upper support tube assembly 658 are illustrated in FIG. 53D. As shown therein, a relatively conventional spring clip 664 may be secured at the top of the support tube assembly 658 to the upper portion of a threaded rod 666. The spring clip 664 may be releasably secured to various types of overhead supporting elements. The threaded rod 666 extends downwardly and terminates within a conduit 670. The conduit 670 may be of a tubular configuration, preferably electrically isolated (i.e., constructed of steel or other metallic components). The conduit 670 can extend downwardly and may be utilized for purposes of carrying electrical and/or communication wires or cables from the structural channel system 606 to the spaced elements 602. The threaded rod 666 may be threadably received into an aperture (not shown) of a conduit cap 668, illustrated in the sectional view in FIG. 53D. In turn, the conduit cap 668 may have internal threads for purposes of securing the cap 668 to a threaded upper portion of the conduit 670. Although this configuration illustrates one embodiment of a means for supporting the space division system 600 from overhead supporting elements, and for providing a means for extending electrical and communication wires and cables from an overhead system downwardly to the spaced elements 602 (in an isolated manner), various other configurations may also be utilized, without departing from the principal concepts of the invention.
The upper support tube assembly 658 extends downwardly and is secured to one end of one of the adjustable links 616, as primarily shown in FIGS. 53 and 53E. This coupling of the second support pole assembly 620 with an adjustable link 616 of the upper material support linkage assembly 614 is referenced in FIGS. 53 and 53E as the second pole/link connector 672. With reference to not only FIGS. 53 and 53E, but also FIG. 53M, the second pole/link connector 672 is coupled at its upper end to the conduit 670 through a threaded cap 674. The threaded cap 674 is keyed at its lower end so as to appropriately receive an upper end 678 of the second lower support pole 660. Tabs 680 at the top portion of the second lower support pole 660 can be inserted into keyed slots (not specifically shown) in the threaded cap 674. A spacer 676 is positioned intermediate upper and lower portions of the adjustable link 616 to which the second pole/link connector 672 is interconnected. The spacer 676 receives the upper end 678 of the second lower support pole 660. In accordance with foregoing, the upper support tube assembly 658 is interconnected with the second lower support pole 660, and the two are interconnected to the left-most adjustable link 616 as illustrated in FIGS. 53 and 53A.

The second lower support pole 660 will now be described primarily with respect to FIGS. 53K, 53L, 53M and 53N. With reference to these drawings, the second lower support pole 660 includes the upper conduit plug 678 as previously described herein. The upper conduit plug 678 includes tabs 680. The upper conduit plug 678 can be plowed or otherwise secured to the upper end of an elongated conduit pole 682. At the lower end of the conduit pole 682, a second conduit plug, referred to herein as a lower conduit plug 678, is coupled to the lower end of the conduit pole 682 and comprises the configuration and shape shown in FIG. 53N. In fact, the upper conduit plug 678 and the lower conduit plug 686 can be the same component, with the lower conduit plug 686 also having a pair of tabs 680 for purposes of keying the lower conduit plug 678 into an appropriate securing connection. As with the upper conduit plug 678, the lower conduit plug 686 can be secured to the lower end of the conduit pole 682 by any suitable means, such as the plug wrench 684 illustrated in FIG. 53M.

Reference is now made to the circle 53H in FIG. 53A and FIG. 53H itself, which show the lower end of the left most second support pole assembly 620. With reference primarily to FIG. 53H, and as previously described herein, the conduit pole 662 is coupled at its lower end to the lower conduit plug 686. The lower conduit plug 686 may be keyed into supporting elements through the use of the tabs 680. The lower conduit plug 686 may also be threaded at its lower end, so as to receive a coupling nut 688. The coupling nut 688 may be included in a threaded aperture extending completely through, so as to threadably receive, at its lower end, a leveling guide 690. These components of the second support pole assembly 620 can be coupled to one end of the adjustable link 616 illustrated in FIG. 53I, with the lower conduit plug 686 extending between upper and lower portions of the adjustable link 616. An elongated portion of the lower conduit plug 686 can be received through an aperture within a spacer 676 and sized so as to snugly fit between upper and lower portions of the end of the adjustable link 616. The leveling guide 690 is a relatively conventional component, and may be used to appropriately level the space division system 600 for purposes of facilitating stability and support.

The space division system 600 illustrated in FIG. 53A also includes an intermediate support rod assembly 622. In the particular embodiment illustrated in FIG. 53A, the intermediate support rod assembly 622 can, in fact, be the same set of components as the second support pole assembly 620 previously described herein. Accordingly, the intermediate support pole assembly 622 will not be described in detail herein.

As further illustrated in FIG. 53A, the particular space division system 600 shown therein includes a series of four rod assemblies 625. These rod assemblies 625 provide intermediate lateral support along the length of the spaced elements 602. Details regarding each of the rod assemblies 625 are illustrated in FIGS. 53A, 53L, 53M and 61C. FIG. 61C is essentially an enlarged and sectional view of FIG. 53I. With reference first to the lower ends of the rod assemblies 625, and with specific reference to FIGS. 53L and 61C, each rod assembly 625 includes an elongated frame rod 692. These elongated frame rods 692 are shown in their entirety in FIG. 53A.

Extending from a lower end of the elongated frame rod 692 is a second conduit plug 694. As shown in FIGS. 53L and 61C, a clevis-like end 700 at the upper end of the second conduit plug 694. The clevis-like end 700 may be secured in any suitable manner to the lower end of the frame rod 692, such as by plug welding or the like. The second conduit plug 694 includes an elongated portion 696 extending downwardly from the clevis-like end 700. The lower end of the second conduit plug 694 can be received within one of the coupling nuts 688. In turn, the coupling nut 688 can threadably receive one of the leveling guides 690. The elongated portion 696 of the second conduit plug 694 extends downwardly through a link mid-aperture 702 of one of the adjustable links 616. Tabs 698 can be keyed into slots (not shown) associated with the adjustable link 616. These slots and the link apertures will be described in detail in subsequent paragraphs herein.

The upper end of the rod assembly 625, and its interconnection to an adjustable link 616 of the upper material support linkage assembly 614 is illustrated in FIG. 53J. Therein, although not specifically shown in detail, the upper end of the elongated portion 696 can be attached to another second conduit plug 694, and turned upwardly in a reverse configuration relative to the second conduit plug 694 located at the lower end of the frame rod 692. The upper second conduit plug 694 can also include a clevis-like end 700 (not shown in FIG. 53J but corresponding to the clevis-like end 700 shown in FIG. 53I). An elongated portion 696 can extend upwardly from the clevis-like end 700, through a link mid-aperture 708. The upper second conduit plug 694 can also include tabs 698 which are keyed into slots (not shown) of the adjustable link 616. The upper second conduit plug 694 can be secured to the adjustable link through the use of a hex nut 704 and washer 706. In this manner, any of the rod assemblies 625 can be secured as “intermediate” supports for the space division system 600.

The first support pole assembly 618 will now be described with respect to FIGS. 53A, 53C, 53L, 53G, 53O, 53P, 53Q and 53R. The particular space division system 600 illustrated in FIG. 53 includes one first support pole assembly 618. The upper portion of the first support pole assembly 618 comprises an upper support tube assembly 658. The upper support tube assembly 658 corresponds to the upper support tube assembly 658 previously described with respect to the second support pole assembly 620 and the intermediate sup-
port pole assembly 622. Accordingly, the upper support tube assembly 658 utilized with the first support pole assembly 618 comprises a spring clip 664, threaded rod 666, conduit cap 668 and conduit 670. These components were previously described herein, and illustrated in FIG. 53D with respect to the second support pole assembly 620. Turning to FIG. 53G, the lower end of the upper support tube assembly 658 is releasably coupled to a first pole/link connector 710. The first pole/link connector 710 has a configuration substantially similar to the configuration of the second pole/link connector 672 previously described herein with respect to FIG. 53E. However, as will be apparent from subsequent description herein, the first pole/link connector 710 utilized with the first support pole assembly 618 is coupled to what can be characterized as components extending laterally outward from the “right” side of one of the adjustable links 616. In contrast, and as illustrated in FIG. 53, the second support pole assembly 620 utilizes a second pole/link connector 672 which couples the pole assembly 620 to components of an adjustable link 616 which extend laterally outward from the “left” of the adjustable link 616, as viewed in illustrations subsequently described herein.

[0209] The first pole/link connector 710 is utilized to interconnect the upper material support linkage assembly 614 to the upper support tube assembly 658 of the first support pole assembly 618, and the first lower support pole 662. Referring to the first lower support pole 662, the same is illustrated in FIGS. 53A, 53F, 53G, 53O, 53P, 53Q and 53R. With reference to these drawings, it is apparent from the same that the first lower support pole 712 is substantially similar to the second lower support pole 660. That is, the first lower support pole 712 comprises an elongated conduit pole 714. The elongated conduit pole 714 is similar to the elongated conduit pole 682 of the second lower support pole 660 previously described herein. The first lower support pole further comprises an upper conduit plug 716, similar to the previously described upper conduit plug 678. The upper conduit plug 716 includes a set of opposing tabs 722 (FIG. 53Q). The tabs 722 are adapted to be keyed into slots within apertures extending through one end of an adjustable link 616 to which the lower support pole 712 is connected. The upper conduit plug 716 can be plug welded or otherwise secured to the upper end of the elongated conduit pole 714. The plug welds are shown at locations 720 in FIG. 53R.

[0210] The lower end of the first lower support pole 712 is primarily illustrated in FIGS. 53A, 53F, 53O and 53P. With reference primarily to FIG. 53F, the lower end of the first lower support pole 712 includes the lower end of the elongated conduit pole 714. Extending outwardly and downward from the conduit pole 714 is a lower conduit plug 718. The lower conduit plug 718 can be secured in size and structure to the upper conduit plug 716. Accordingly, the lower conduit plug 718 can include plug welds 720 for securing the same to the elongated conduit pole 714. The lower conduit plug 718 extends downwardly through a first upper bracket 728 of the right-hand side of one of the lower ones of the adjustable links 616. These interconnections will be described in greater detail herein. The lower conduit plug 718 also extends through an aperture of a lower bracket 730 of the adjustable link 616. A spacer 726 is positioned between the upper and lower brackets 728 and 730, and includes an aperture through which the lower conduit plug is extended. The lower conduit plug 718 also includes tabs 722 which can be keyed into slots within the lower bracket 730. A threaded cap is also utilized, as primarily illustrated in FIG. 53F. The upper end of the threaded cap is threadably received onto a lower end of the lower conduit plug 718. Correspondingly, a lower end of the threaded cap 724 is threadably received in one of the leveling guides 690. The combination of the brackets 728 and 730 of the adjustable link 616, along with the lower conduit plug 718, threaded cap 724 and spacer 726 can be characterized as a first lower pole/link connector 732.

[0211] Returning to the upper end of the first lower support pole 712, the coupling of this pole 712 with the upper support tube assembly 658 and a right side adjustable link 616 of the upper material support linkage assembly 614 will now be described primarily with respect to FIG. 53G. The first pole/link connector 710 includes a threaded cap 734. As shown in FIG. 53G, the threaded cap 734 extends upwardly and is threadably received at the lower end of the upper support tube assembly 658. Correspondingly, the lower end of the threaded cap 734 threadably receives the upper conduit plug 716 of the first lower support pole 712. The upper conduit plug 716 extends upwardly through an upper bracket 734 and a lower bracket 740 of the right-most adjustable link 616 of the upper material support linkage assembly 614. The upper conduit plug 716 also includes tabs 722 which will fit within slots associated with apertures extending through the brackets 738, 740. In accordance with the foregoing, the first pole/link connector 710 can be characterized as including the brackets 738, 740, spacers 736 and threaded cap 734. The foregoing discussion substantially describes in detail the support pole assemblies which may be utilized with the space division system 600 in accordance with the invention. However, it should be emphasized that these supporting assemblies comprise only a single embodiment of the space division system 600 in accordance with the invention. Other configurations may be utilized without departing from the principal concepts of the invention.

[0212] The use of the material support linkage assemblies 610 will now be described, primarily with respect to FIGS. 54-629. The material support linkage assemblies 610 are significant to the principal concepts of space division systems in accordance with the invention. In part, the material support linkage assemblies 610, with their adjustable links 616, allow for various patterns to be formed of the space division system 600, and other space division systems employing the material support linkage assemblies. Also, the material support linkage assemblies 610 provide a means for facilitating ease of use, with respect to assembly, disassembly and storage. As earlier described, the linkage assemblies 610 allow the system 600 to be shaped into desired forms, and not necessarily in any predetermined shapes. Still further, the spaced elements 602 can be reshaped into various forms, and can be free-standing. Zipper connections allow for the side sections 604 to be attached to one another on both sides of one length of the system 600, or in a contiguous manner to adjacent side sections 604 on the same side, thereby providing additional flexibility and space management.

[0213] As previously described herein, vertical support pole and rod assemblies can be utilized with the system 600, for purposes of providing structural support and general stability. Still further, the material support linkages in accordance with the invention provide means for adjusting the shapes and general configurations of the space division 600, while firmly retaining reelseable support of fabrics or other materials associated with the spaced elements 602. Still further, with the configurations of the material support linkage
assemblies in accordance with the invention, the assemblies reduce the “bunching” effect which often occurs with materials, when space dividers are being formed into various shapes, after being initially coupled to support structures when the fabrics and other materials are in a “straight line” configuration. Turning to the drawings, the material support linkage assemblies 610 and the illustrative embodiment of the space division system 600 in accordance with the invention comprise two support linkage assemblies, namely a lower material support linkage assembly 612 and an upper material support linkage assembly 614, as illustrated primarily in FIG. 53. As earlier described herein, each of the material support linkage assemblies 610 is constructed of adjustable links 616 which are releasably coupled together and secured to fabrics or other materials of the side sections 604 as described in subsequent paragraphs herein. As also described in subsequent paragraphs herein, the adjustable links 616 of each material support linkage assembly 610 can be “rotated” or “pivoted” relative to an adjacent verticallyadjustable link 616, so as to form various and desired patterns for the spaced elements 602 of the space division system 600. It should be noted that this feature provides for substantially greater scope of space division system patterns (meaning various formations or configurations) than exist when the spaced elements 602 can only be rotated relative to adjacent spaced elements 602. Further, it should be noted that the degree of resolution attained in terms of degrees and “smoothness” of curvature in the patterns can be made dependent upon the sizes of the adjustable links 616. That is, the greater the “link density” (i.e. the number of adjustable links per length of side sections 604) the greater will be the curvature resolution.

[0214] FIG. 54 illustrates one of the adjustable links, as it would be oriented to be used with the lower material support linkage assembly 612. The separate adjustable links 616 in FIG. 55 are also shown in an orientation for use with the lower material support linkage assembly 612. This orientation also exists in other illustrations of the adjustable link 616. However, it should be noted that FIG. 59, which is a bottom plan view of the adjustable link 616, is shown in an orientation reversed from the orientation shown in the top plan view of the adjustable link 616 illustrated in FIG. 57. The example embodiment of the adjustable link 161 in accordance with the invention will first be primarily described with respect to FIGS. 54-60B. With reference thereto, the adjustable link 616 includes an upper section 752 primarily having the shape illustrated in FIGS. 54 and 57. The upper section 752 extends along the top edge of the adjustable link 616. The link 616 also includes a lower section 754 (primarily shown in FIGS. 54 and 59) which extends along the bottom edge of the adjustable link 616. Again, it should be noted that if the adjustable link is utilized as a link with the upper material linkage assembly 614, the upper section 752 will be at the bottom of the orientation of the link 616, while the lower section 754 will be at the top of link 616.

[0215] The adjustable link 616 also includes a main central body 750. The main central body 750 is formed (as illustrated in FIG. 54) by a web assembly 756 and formed on one end of the adjustable link 616. The web assembly 756 can include an upper web 758, central web 760 and lower web 762. The web assembly 756 can be formed by an inner wall 764, an upper intermediate wall 766, a lower intermediate wall 768, the lower edge 770 of the upper section 752, and an upper edge 772 of the lower section 754.

[0216] Moving to the left side or left end of the adjustable link 616 as oriented in FIG. 54, the link 616 includes a second inner wall 774. The second inner wall 774 is essentially a mirror image of the inner wall 764. Extending further toward the left side of the adjustable link 616 as viewed in FIG. 54 is a flexible indexing tab 776. As will be described in subsequent paragraphs herein, the indexing tab 776 is preferably constructed and configured in a manner so as to provide for some flexibility at its leading edge 778. This flexibility permits the flexible indexing tab 776 to be utilized in conjunction with a ratchet assembly (described in subsequent paragraphs herein) for purposes of providing the capability of angular adjustment of one adjustable link 616 relevant to adjacent adjustable links 616. In the particular embodiment illustrated in FIG. 54, the flexible indexing tab 776 is of a unitary configuration. For purposes of flexibility, the flexible indexing tab 776 is positioned in a manner so that it is not directly connected to either the upper section 752 or the lower section 754. In the particular embodiment illustrated in FIG. 54, the flexible indexing tab 776 is secured (through pop rivets 780 or other connecting elements) to a brace 782 having a first face 784 and a second opposing face 786 (see FIG. 60B). It should be noted at this time that, in accordance with the invention, it is substantially preferable for the flexible indexing tab 776 to be constructed of a material and configured so as to be somewhat flexible and resilient. In this regard, it may be preferable for the indexing tab 776 to be constructed of a plastic material. This flexibility will permit the adjustable link 616 illustrated in FIG. 54 to be capable of pivotal rotation relative to an adjacent link 616 which is rotatably coupled to the link 616 shown in FIG. 54 through the flexible indexing tab 776. This concept will be made more apparent in subsequent paragraphs herein. Correspondingly, the brace 782 may be constructed of a metallic or similar relatively rigid material, so long as it is coupled to the flexible indexing tab 776 in a manner such that the resiliency of the indexing tab 776 is not substantially lessened by its connection to the brace 782.

[0217] Again with reference first to FIG. 54, and turning toward the right hand side of the adjustable link 616 (as viewed in FIG. 54), the link 616 includes a ratchet assembly 788. The ratchet assembly 788 includes a pair of ratchets 790, referred to in FIG. 54 as an upper ratchet 792 and a lower ratchet 794. Although this corresponds to the configuration in FIG. 54, it should be remembered that if the adjustable link 616 is utilized with the upper material support linkage assembly 614, the ratchets 792, 794 would be reversed in vertical disposition.

[0218] The ratchets 790 are primarily shown in FIGS. 54-60A. Each of the ratchets 790 extends laterally outwardly from a pair of arms 796. The arms 796 are connected to or are otherwise integral with the upper web 758 and the lower web 762. Each ratchet 790 has a cylindrical configuration and forms what can be characterized as a cylinder portion 798. Within each cylinder portion 798 is a recessed area 800 which is open at one end of its corresponding ratchet 790. Specifically, the recessed area 800 of the upper ratchet 792 opens upwardly as viewed in FIG. 54. Correspondingly, the recessed area 800 of the lower ratchet 794 opens downwardly as viewed in FIG. 54. Extending partially through the recessed area 800 of each of the ratchets 790 is a sleeve 806. Each of the sleeves 806 includes a throughhole 802 extending vertically therethrough, as primarily illustrated in FIG. 58. Each of the throughholes 802 include a pair of key slots 804. The throughholes 802, with their corresponding key slots
804, will be utilized to receive a tabbed connecting pin 808, as illustrated in FIG. 55. The connecting pin 808 is utilized to mechanically couple together adjacent links 616, while still permitting pivotal movement between the same.

[0219] At the outermost end of each of the ratchets 790 (as viewed at FIG. 54), a ratchet gear 810 is positioned. As shown particularly in FIGS. 56, 57, 59 and 68, each of the ratchet gears 810 includes a set of ratchet teeth 812 extending partially around the outer perimeter of the cylinders 798 of the ratchets 790. The ratchet teeth 812 are oriented so that the teeth 812 themselves, and the gaps therebetween, are vertically disposed.

[0220] As described in subsequent paragraphs herein, the ratchet teeth 812 of one adjustable link 616 are adapted to engage the leading edge 778 of the flexible indexing tab 776 of an adjacent adjustable link 616. It is this engagement between the teeth 812 of one adjustable link 616 and the flexible indexing tab 776 of another, adjacent link 616 which permits the pivotal movement of one of the adjustable links 616 relative to the other adjacent link 616.

[0221] Turning to other elements of the adjustable link 616, the inner wall 764 and second inner wall 774 were previously described herein primarily with respect to FIG. 54. These walls 764 and 774 form a spatial area 814 therebetween. Correspondingly, the upper section 752 of the link 616 also includes a middle spatial area 816. Further, the lower section 754 also includes a centrally located spatial area 818. Extending upwardly into the spatial area 816 is an upper cylindrical sleeve 826. The upper sleeve 826 forms an upper keyed throughhole 820. Correspondingly, a lower cylindrical sleeve 828 extends downwardly from the upper portion of the spatial area 818 of the lower section 754. This lower sleeve 828 forms a lower keyed throughhole 822. Each of the throughholes 820, 822 includes a pair of key slots 824, as shown in FIGS. 57 and 59. The throughholes 820, 822 and the spatial area 814 are adapted to receive the elongated portion of the second conduit plug 694, previously described herein and illustrated in FIG. 53I. In accordance with the prior description, the second conduit plug 694 is utilized with corresponding rod assemblies 625.

[0222] Returning to the left most portion of the adjustable link 616 as viewed in FIG. 54, the upper section 752 includes a spatial area 830, primarily shown in FIGS. 57 and 58. Correspondingly, the lower section 754 also includes a lower spatial area 832, primarily shown in FIGS. 58 and 59. With respect to the spatial area 830, a circular area 834 (FIGS. 57 and 58) is formed therein at the left most end of the upper section 752. Formed at the lower portion of the circular area 834 is an upper sleeve 836 having a cylindrical configuration. Formed within the upper sleeve 836 is a keyed throughhole 838. Correspondingly, with reference to the lower section 754 and the spatial area 832, a lower sleeve 842 extends downwardly from an upper portion of lower section 754. Formed within the cylindrical lower sleeve 842 is another keyed throughhole 844. The keyed throughhole 844 is vertically aligned with the keyed throughhole 838. Each of the throughholes 838, 844 include a pair of key slots 840.

[0223] The keyed throughholes 838 and 844, like the keyed throughholes 802 associated with the ratchets 790, are adapted to receive a connecting link or pin 808, as illustrated in FIG. 55. Further, as apparent from the foregoing description, when the adjustable links 616 are coupled together, the end of one adjustable link 616 having the ratchets 790 is coupled to the end of the adjacent adjustable link 616 through its end having the keyed throughholes 838, 844 and the leading edge 778 of the flexible indexing tab 776. This connection arrangement is illustrated in FIG. 55.

[0224] In accordance with the foregoing description, when the adjustable links 616 are coupled together, the coupling occurs not only through the connecting links 808, but also through the gearing connections between the ratchets 790 associated with one end of one adjustable link 616, and the leading edge 778 of the flexible indexing tab 776 of the adjacent adjustable link 616. This concept is primarily illustrated in FIG. 52A, in the sectional plan view thereof. It should also be noted that the connecting link 808 can include tabs which can be inserted into the key slots 804 of the ratchets 790 and the key slots 840 of the keyed throughholes 838 and 844.

[0225] Reference is now made to the coupling of the adjustable links 616 to the first support pole assembly 618, second support pole assembly 620 and intermediate support pole assembly 622. Also, as previously described herein, the second support pole assembly 620 and the intermediate support pole assembly 622 are substantially the same. Accordingly, only the coupling between the second support pole assembly 620 and the adjustable link 616 will be described. More specifically, reference is made to FIG. 61A, which illustrates the coupling of the first support pole assembly 618 with an end adjustable link 616, where the link 616 corresponds to the right most link 616. This configuration was previously described in detail with respect to FIG. 53I. In that description, reference is made to the concept that the lower conduit plug 718 extends through the ratchets 790 of the end adjustable link 616. Again, this coupling is described in detail with respect to FIG. 53F.

[0226] Correspondingly, FIG. 61B illustrates the coupling of the second support pole assembly 620 to the left most adjustable link 616 of the lower material support linkage assembly 612. More specifically, FIG. 61B illustrates the coupling between the left most adjustable link 616 and the elongated portion of the lower conduit plug 686. The coupling of the lower conduit plug 686 to the left most adjustable link 616 was previously described in detail with respect to FIG. 53H. Still further, FIGS. 61A and 61B illustrate the use of a keyed connector link 808 which may be utilized for purposes of coupling together two adjacent adjustable links 616.

[0227] Similar types of couplings are utilized for interconnecting the first support pole assembly 618 and second support pole assembly 620 to adjustable links 616 of the upper material support linkage assembly 614. More specifically, the coupling between a left most adjustable link and the second support pole assembly 620 is illustrated primarily with respect to FIG. 53E, showing the coupling of the adjustable link 616 and the upper conduit plug 678. Correspondingly, the coupling between the first support pole assembly 618 and the right most adjustable link 616 of the upper material support linkage assembly 614 is primarily illustrated in FIG. 53G. FIG. 53G illustrates the coupling specifically between the upper conduit plug 716 and the right most adjustable link 616 of the upper material support linkage assembly 614.

[0228] FIGS. 62A and 62B specifically illustrate the concept of the use of a material support linkage assembly 610 and the capability of pivotal rotation of individual links 616 of the support assembly 610 relative to adjacent individual links 616. As previously described, FIG. 62A illustrates the concept that when one adjustable link 616 is coupled to an adjacent adjustable link 616, the leading edge 778 of the flexible
indexing tab 776 of one of the adjustable links is engaged with the ratchet teeth 812 of the two ratchet gears 810 associated with the pair of ratchets 790 of the adjacent adjustable link 616. Specifically, FIG. 62A illustrates the "straight line" orientation of two adjacent adjustable links, with one of the links being shown in phantom line format. In solid line format, FIG. 62A illustrates the concept that by moving one of the adjustable links 616 so that the leading edge 778 of its flexible indexing tab 776 engages other teeth 812 of the ratchet gears 810, the adjustable links 616 can be rotated relative to each other. FIG. 62B illustrates a particular configuration using a series of adjustable links 616. It should be emphasized, and in accordance with a principal concept of the invention, that the flexible indexing tab 776 should exhibit some flexibility and resiliency for the leading edge 778 to be manually rotatable along the teeth 812 of the ratchet gears 810 associated with the adjacent adjustable link 616. Further, it may be preferable for the ratchets 790 having the coupled ratchet gears 810 to also exhibit some flexibility or resiliency. Without the relative flexibility or resiliency between the leading edge 778 and the ratchet gears 810, it would not be possible to move the leading edge 778 of the flexible indexing tab 776 from one set of ratchet teeth 812 to another set of ratchet teeth 812 of the adjacent ratchet gears 810. That is, if the leading edge 778 and the ratchet gears 810 were both completely "hard" and stationary, such movement would not be capable, in that the leading edge 778 or teeth 812 could not flex in a manner so as to permit movement from one set of teeth 812 to another set of teeth 812.

[0229] Reference will now be made to concepts associated with the coupling of side sections 604 to each other. Specifically, FIG. 63A illustrates a configuration where a first side section 603 is coupled at an end of a material support linkage assembly 610 to the opposing second side section 605 (not specifically shown). In this situation, and as illustrated in FIG. 63A, a zipper connection 846 is utilized. The zipper connection 846 employs a conventional zipper 848. The zipper 848 positioned at a terminating end of a pair of end pieces 850. The end pieces 850 are connected to the side sections 604 through any desired material connections 852. This concept of the use of the zipper connection 846 to couple together opposing side sections 604 is also illustrated in FIGS. 66A and 66B.

[0230] A configuration is also illustrated herein with respect to coupling together side sections 604 which are adjacent and located on the same side of the space division system 600. Such a configuration is illustrated in FIG. 63B and utilizes what is characterized as a second zipper connection 854. Again, the second zipper connection 854 includes a zipper 848 with end pieces 850 attached to opposing ends of the pair of side sections 604. It should be emphasized that the side sections 604 may be on either side or both sides of the space division system 600. The end pieces 850 are connected to the side section 604 through material connections 852, which may be any suitable type of connections.

[0231] Reference will now be made to the concept of coupling the side sections 604 to the adjustable links 616. In this regard, FIG. 64 (a sectional view from FIG. 63B) illustrates means for connecting the side sections 604 to the adjustable links 616. As shown in FIG. 64, and with reference to FIGS. 54, 55 and 57, along with FIG. 64, the adjustable links 616 each include a material connector 856 on each side of the link 616. As shown in these illustrations, when an adjustable link is used for the lower material support linkage assembly 612, the material connectors 856 essentially form a J channel 858 which is open at its lower end. Correspondingly, as illustrated in FIG. 53, when an adjustable link 616 is utilized as part of the upper material support linkage assembly 614, the J channel 858 of the material connectors 856 opens upwardly, due to the reversal in orientation of the adjustable links 616.

[0232] Further, as illustrated, for example, in FIGS. 53 and 64, each of the side sections 604 can include a connector hook 860. Each connector hook 860 can be in the form of an elongated material strip having a J hook 862. In the adjustable links for the lower material support linkage assembly 612, the J hooks 862 open upwardly. When the connector hooks 860 are utilized with the upper material support linkage assembly 614, the J hooks 862 open downwardly. As shown in FIG. 53, each of the connector hooks 860 may be in the form of an elongated strip. The connector hooks 860 may be coupled to the fabrics of the side section 604 through the use of connectors 864 or similar connecting means. Alternatively, the connector hooks 860 may, for example, have an adhesive backing which permits the connector hooks 860 to be adhesively attached to the side sections 604. FIG. 65 illustrates, in elevation view, the inside of a side section 604 showing the upper and lower connector hooks 860.

[0233] Reference will now be made to various connection arrangements between the upper support tube assemblies 658 and various structural elements comprising the overhead system to which the space division system 600 is connected. This overhead system has been referred to herein as the structural channel system 606. With reference to FIGS. 67 and 68, the upper support tube assemblies 658 can be coupled to overhead structural elements characterized as support rails 866. These structural configurations of the support rails 866 will not be described in detail herein. However, these support rails 866 are described in detail in the visual shield application previously referenced herein, and incorporated by reference herein. The visual shield application also describes the concept of interconnection of the support rails 866 to the structural channel rails 606.

[0234] Turning again to FIGS. 67 and 68, the upper support tube assembly 658 shown therein has a somewhat different upper configuration than as shown in FIG. 52, in that the configuration shown in FIG. 52 illustrates the use of spring clip connections or similar connections 636. In this particular connector arrangement, a support rail connector 870 is utilized. At the upper aperture of the upper support tube assembly 658 is a threaded portion, in which a threaded support rod 868 may be received. The support rail connector 870 includes an L-shaped portion 872 with a lower base 874. The lower base 874 can include an aperture (not shown) with a threaded bushing 892 positioned immediately above the aperture. The upper end of the threaded support rod 868 is adapted to be threadably received within the aperture and the threaded bushing 892. A nut 886 is utilized to fix the position of the threaded support rod 868 within the aperture and threaded bushing 892.

[0235] The L-shaped portion 872 includes a lower base 874, within which the aperture and threaded bushing 892 are positioned. The lower base 874 is integral with a vertical leg 876 which extends vertically upwardly, and terminates in a lip 878. The lip 878 essentially curls around a support rail leg 890 located on one side of the support rail 866. A separate element characterized as a connector bracket 880 which still forms part of the support rail connector 870, is positioned as shown in FIGS. 67 and 68, and is horizontally disposed. The con-
nector bracket 880 includes a terminating and upwardly directing lip 894 which essentially “captures” a lower support rail base 888 above the connector bracket 880. At one end of the connector bracket 880, a T-bar 882 extends outwardly through a T-slot 884 located in the vertical leg 876 of the L-shaped portion 872 (see FIG. 68). The interaction between the T-bar 882 and the T-slot 884 limits the relative positioning of the connector bracket 880 and the lower base 874. When the upper support tube assembly 658 has been coupled to the support rail 866 as shown in FIG. 67, the connection can be disassembled by first loosening the nut 886. After the nut is sufficiently loosened, the vertical leg 876 is free to move sufficiently downwardly, so that the T-bar 882 can be moved into the upper horizontal leg of the T-slot 884. With this movement, the T-bar 882 can be removed from the T-slot 884, and the connector bracket 880 can then be disengaged from the L-shaped portion 872. It should be noted that this particular configuration represents only one embodiment of a connection arrangement between the support rails 866 and the upper support tube assembly 658, and other arrangements can be utilized without departing from certain of the principal concepts of the invention.

Reference will now be made to connection arrangements between the upper support tube assembly 658 and direct connections to the structural channel rails 607. With reference specifically to FIGS. 69 and 70, and first referring to the exploded view of FIG. 70, a structural channel connector assembly 894 is provided for use in connection of the upper support tube assembly 658 to the structural channel rail 607. With reference first to FIG. 70, the structural channel connector assembly 894 includes one L-shaped bracket 896 and a modified L-shaped bracket 897. The L-shaped mounting bracket 896 includes a horizontal base 900 having a substantially horizontal plane. In contrast, the modified L-shaped bracket 897 includes a modified base 901 which is substantially horizontal but is in somewhat of a partial raised configuration as specifically shown in FIG. 70. Other components of the L-shaped bracket 896 and modified L-shaped bracket 897 are substantially the same, and will be like-numbered.

Each of the horizontal bases 900, 901 includes a threaded aperture 902 extending through the central portions thereof. Each L-shaped bracket 896, 897 also includes a vertical leg 904 extending upwardly, and terminating at its side edges in a pair of spades 906. At the central, upper portions of the vertical legs 904 are curved portions 908, each terminating in a lip 910. Each of the curved portions 908 also includes a modified T-slot 912 having a particular shape and configuration as illustrated in FIG. 70.

The structural channel connector assembly 894 also includes a separate component, illustrated in FIG. 70 and identified as a connector 898. The connector 898 is a singular piece having a center raised portion 914. Vertical legs 916 extend upwardly from each end of the center raised portion 914. Each of the vertical legs 916 terminates in a T-bar 918. As shown primarily in FIG. 69, the structural channel connector assembly 894 can be connected to a structural channel rail 607 by mating the L-shaped brackets 896, 897 together (as shown in FIG. 69) and then threadably engaging the threaded support rod 868 through the threaded apertures 902. The connector 898 can then be positioned so that the T-bars 918 extend upwardly through the modified T-slots 912. With this configuration, the lips 910 of the curved portions 908 extend around and capture elements of the structural channel rail 607 as specifically illustrated in FIG. 69. The threaded rod 868 can then be brought upwardly through the threaded apertures 902 sufficiently so as to rigidly secure the structural channel connector assembly 894 to the structural channel rail 607. When it is desired to disassemble the connection between the rail 606 and the upper support tube assembly 658, the threaded rod 868 can be threadably disengaged from the apertures 902, thereby permitting the L-shaped brackets 896, 897 to be moved upwardly a sufficient distance so as to disengage the curved portions 908 from the structural channel rail 607. It should be emphasized that details regarding the configuration of the structural rail 607 are set forth in detail in the channel system application.

The structural channel system 606 can also include other types of supporting rails, such as the supporting brace 920 illustrating in FIGS. 71 and 72. Therein, a supporting brace 920 is illustrated, which may be a type of brace which is utilized with the structural channel system 606. The supporting brace 920 includes a top portion 922, and a pair of integral downwardly projecting sides 924. At the bottom of the sides 924, a pair of lips 928 curve back upwardly. The supporting brace 920 can also include apertures in the top portion 922, for purposes of running electrical wires, sprinkler systems or other devices downwardly through the supporting brace 920. One aperture 926 is partially shown in FIG. 72.

For connection, a brace connector assembly 931 is utilized with an upper support tube assembly 658 and the supporting brace 920. The brace connector assembly 931 includes a horizontal base 932. The horizontal base 932 includes curved end portions 934, which curve upwardly on each side of the base 932. A separate mounting bracket 936 is also provided, with the configuration primarily shown in FIG. 72. The mounting bracket 936 includes a pair of opposing downwardly curved portions 938. At the top of the mounting bracket 936 is a threaded bushing 940. Although not specifically shown in the drawings, the threaded bushing 940 is positioned above a central aperture in the mounting bracket 936. For purposes of interconnection, the upper support tube assembly 658 can include a threaded rod 868 extending upwardly therefrom. The brace connector assembly 931 can be positioned so that the threaded rod extends through a central aperture of the horizontal base 932 and upwardly through the aperture (not shown) in the mounting bracket 936. Further upward movement will cause the threaded support rod 868 to be threadably received within the threaded bushing 940, as illustrated in FIGS. 71 and 72. A nut 930 can be utilized to fixedly secure the threaded support rod 868 in a desired position, relative to the brace connector assembly 931. This position, for securing the supporting brace 920 to the threaded support rod 868 is illustrated, in particular, in FIG. 71. Therein, it is shown that the downwardly curved portions 938 abut the inner portions of the upwardly turned lips 928 of the supporting brace 920. In this position, the brace connector assembly 931 is secured to the supporting brace 920. To disengage the brace connector assembly 931, the nut 930 can be loosened, so that it is disengaged from the threaded bushing 940. Again, FIGS. 71 and 72 illustrate one embodiment of a brace connector assembly 931 which may be utilized in accordance with the invention. Numerous other connection arrangements for connection of the upper support tube assembly 658 to overhead system elements of the struct-
tural channel system 606 or other overhead systems may be utilized, without departing from certain of the principal concepts of the invention.

[0241] FIGS. 63A and 63B, as previously described herein, illustrate the use of zipper connections 846, 854, respectively, at the ends of side sections 604 and at mid points between adjacent side sections 604. FIG. 73 is substantially similar to FIG. 63A, and illustrates the upper portion of the zipper connection 846 and the coupling of the configuration to an upper support tube assembly 658. Also shown therein, in a substantially enlarged view, is the adjustable link 616 located at that particular end of the configuration of the space division system 600.

[0242] As previously described herein, the space divider system 600 can be utilized in various formats. For example, FIG. 74 illustrates the space divider system 600 as having side sections 604 with a height Z. Based on the sizes of the side sections 604, the height Z can be varied. Variations in the height of the side sections 604 will not necessarily require the use of any different components with respect to the material support linkage assemblies 610 or other components of the space division system 600. In this regard, the support pole assemblies 617 can be cut to desired heights, dependent upon the desired height Z.

[0243] Still further, FIG. 75 illustrates the concept of potentially “stacking” a pair of space division systems 600. More specifically, FIG. 75 illustrates the use of the space division system 600 at a top portion and a second space division system 942 below the space division system 600.

[0244] As will be apparent from the prior description herein, when the space division system 600 is constructed, with the opposing side sections 603, 605, a “void” area will be located between the side sections 605, 605, with the void having a depth which corresponds at least to the depth of an adjustable link 616. FIG. 76 is a sectional, plane view of a void 944 which may exist between two side sections 603, 605, with the adjustable links 616 therebetween. In such a void 944, various types of application devices may be employed. For example, FIG. 76 illustrates the concept of a flat panel display or flat panel speaker 946 which may be secured in any suitable manner within the void 944. If the side sections 604 are made of a translucent material, the flat panel display 946 could be utilized to project images.

[0245] Also, for purposes of utilizing various types of electronic or other electrical devices with the space division system 600, a “subsystem” can be utilized for purposes of application of low voltage power (DC or otherwise) to the space division system 600, for purposes of powering various application devices. In this regard, reference is made to the block diagram of FIG. 77, which illustrates the use of a DC subsystem 948. More specifically, FIG. 77 illustrates the concept of receiving AC power from an AC power network 950 on a power line 952. Concepts associated with distribution of AC power in an overhead electrical network and structural channel system are described in detail in the channel system application, previously referenced herein, and incorporated by reference herein. The AC power on power line 952 can be applied as input to a conventional transformer 954. The transformer 954 can be utilized to convert the incoming AC power to DC power. The DC power can be applied as output power from the transformer 954 on DC power lines 956. Such DC power lines 956 may be external to the upper support tube assembly 658 or, alternatively, may be run through the support tube assemblies 658 and through conduit pipes or tubes associated with the support pole assemblies 617, such as pole assemblies 618, 620. Still further, for purpose of distribution among the various spaced elements 602 of the space divider system 600, the DC power lines 956 can be applied through an electronic transfer hub 958 to DC sublines 960. The DC sublines 960 can then be appropriately connected, by any conventional means, within the voids 944 (or outside of the voids) of the space divider system 600. In this manner, low voltage power (DC or otherwise) can be distributed throughout the space divider system 600.

[0246] In addition to utilization of electronic elements within the void 944 (as illustrated in FIG. 76), the side sections 604, which may comprise of fabric material, can be cut so that other electronic elements can be utilized with the space divider system 600. For example, FIG. 78 illustrates a plan view of a pair of side sections 603, 605 showing the void 944 therebetween, and showing an example of an adjustable link 616 also positioned therebetween. An opening 964 has been cut into the material of the first side section 603. A conventional speaker 962 is extended through the opening 964, as illustrated in FIG. 78. The speaker can be connected to electronic wires or other components through, for example, the DC subsystem 948 previously described herein with respect to FIG. 77.

[0247] A number of concepts associated with the invention have been described herein. With respect to the material support linkage assemblies 610, various principal concepts of the invention are associated. For example, with the use of flexibility and the couplings between leading edges 778 and ratchet gears 810, adjacent adjustable links 616 are capable of pivotal rotation relative to each other. Still further, if fabric or other types of materials which exhibit at least a minimum of stretch properties are utilized for the side sections 604, various configurations of the space division system 600 can be achieved, without the conventional problems of “bunching” of materials. This advantage exists in substantial part because of the configurations and concepts associated with the material support linkage assemblies 610 (with their attendant adjustable links 616) and the means for coupling the materials of the side sections 604 to the adjustable links 616.

[0248] It will be apparent to those skilled in the pertinent arts that other embodiments of space division systems in accordance with the invention may be designed. That it, the principles of space division systems in accordance with the invention are not limited to the specific embodiments described herein. Accordingly, it will be apparent to those skilled in the art that modifications and other variations of the above-described illustrative embodiments of the invention may be effected without departing from the spirit and scope of the novel concepts of the invention.

1. A space division system for use with an overhead system within a building infrastructure, said space division system comprising:

- a plurality of vertical panels comprising side sections;
- an upper material support linkage assembly coupled to an upper portion of said vertical panels;
- a lower material support linkage assembly coupled to a lower portion of said vertical panels; and
- each of said material support linkage assemblies comprises adjustable links having pivot means for permitting pivotal movement between adjacent ones of said adjustable links of said material support linkage assemblies.

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