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[54] **UNIVERSALLY MOUNTED POWER STRIP**

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[57] ABSTRACT

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A power strip supporting a plurality of power outlets for distributing power within an electronic cabinet or to an electronic rack has two identical housing pieces each having a right angle corner between a bulbous end and a groove end all of which extending the entire length of the housing, such that, when the bulbous ends are slidably inserted into the groove ends, the two pieces form a substantially square cross section of improve strength of construction having two tightly fitted mated corners and the two right angle corners all four of which are formed with a flange also extending the length of the power strip then adapted to received one or more clips which may be clipped onto the power strip on any one side and anywhere along the length of the power strip so that the power strip can be fastened by a hole in the clips to a cabinet or rack in a variety positions to face the power outlets in a variety of desired directions for ease of routing power wires which may be further routed through wiring routers also fastened using the clips in a variety of positions along the power strip at the ends of which are plastic end caps using screws screwed into the right angle corners to prevent the two pieces from sliding relative to each other.

[52] U.S. Cl. **439/211**; 439/114; 439/535; 439/209; 174/48

[58] Field of Search 439/207, 209, 439/210, 211, 212, 214, 501, 535, 208; 174/48, 49, 70 C, 72 C

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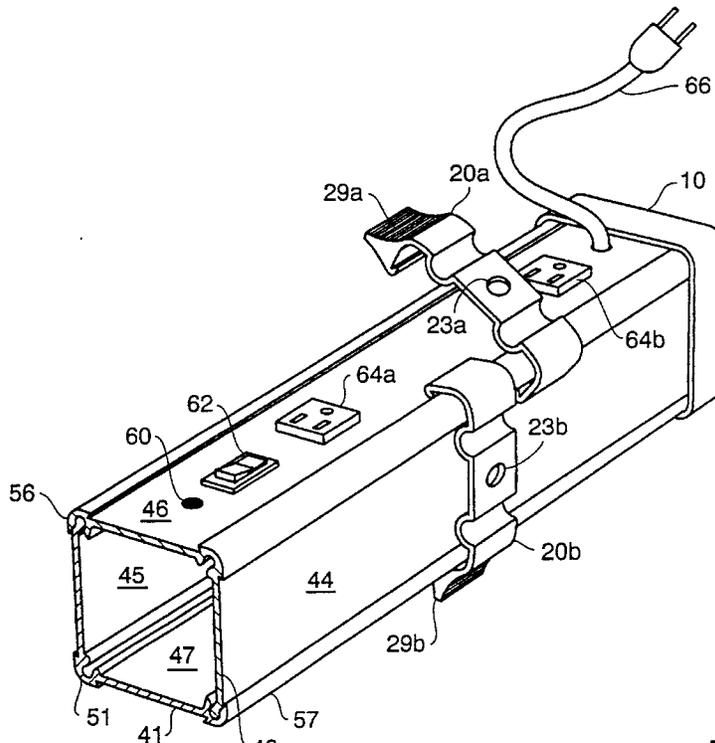
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13 Claims, 2 Drawing Sheets



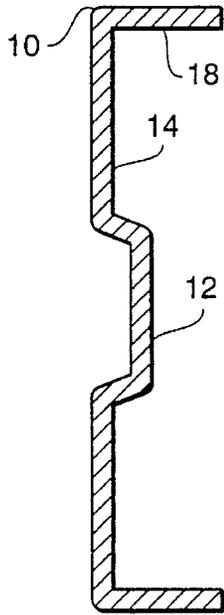


FIG. 1b

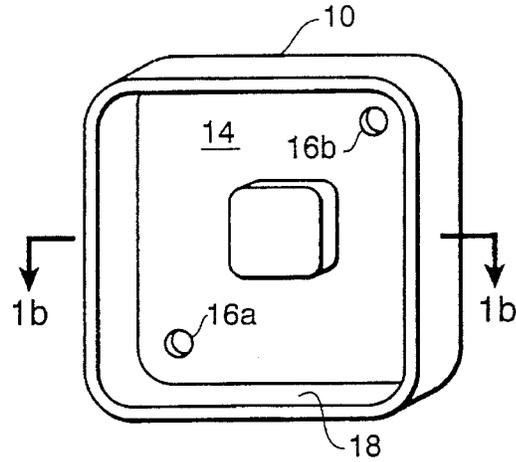


FIG. 1a

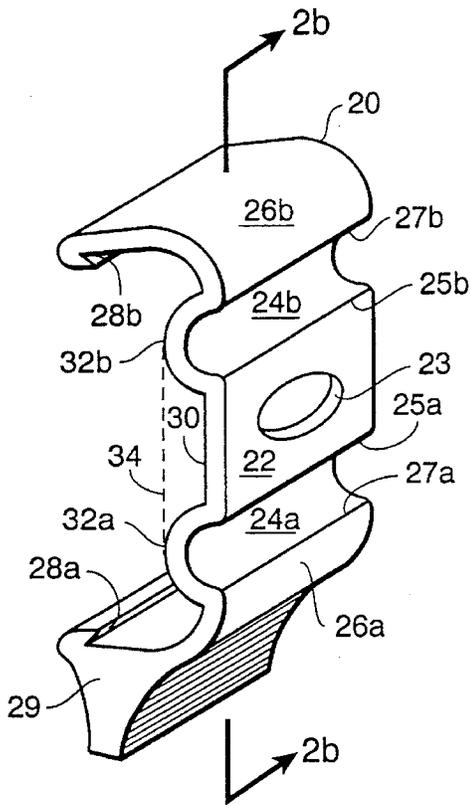


FIG. 2a

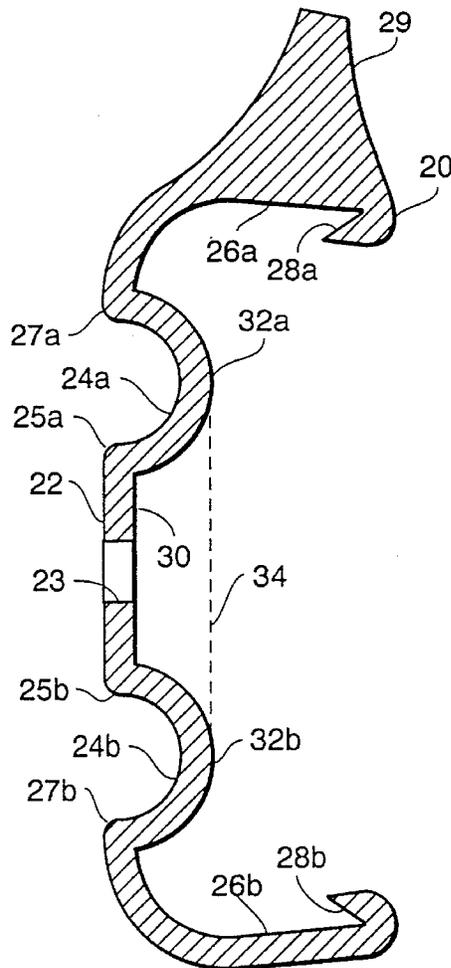


FIG. 2b

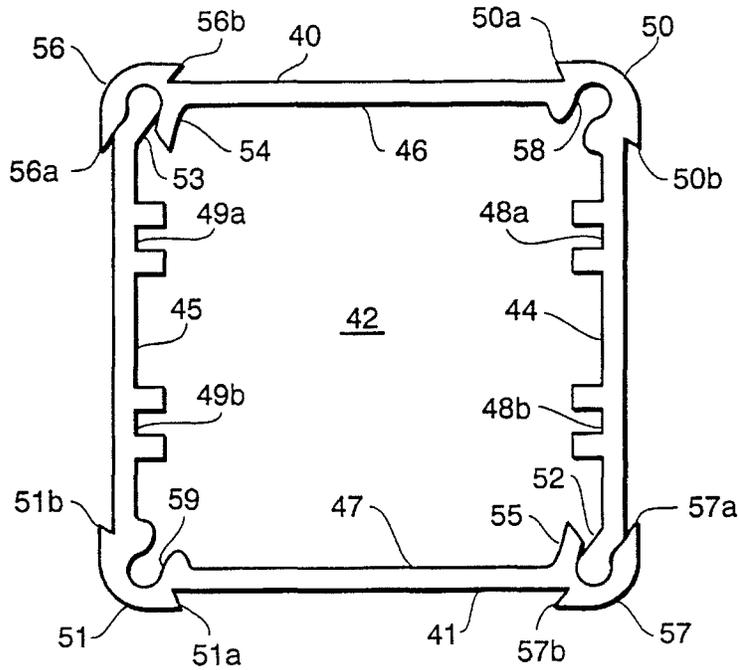


FIG. 3a

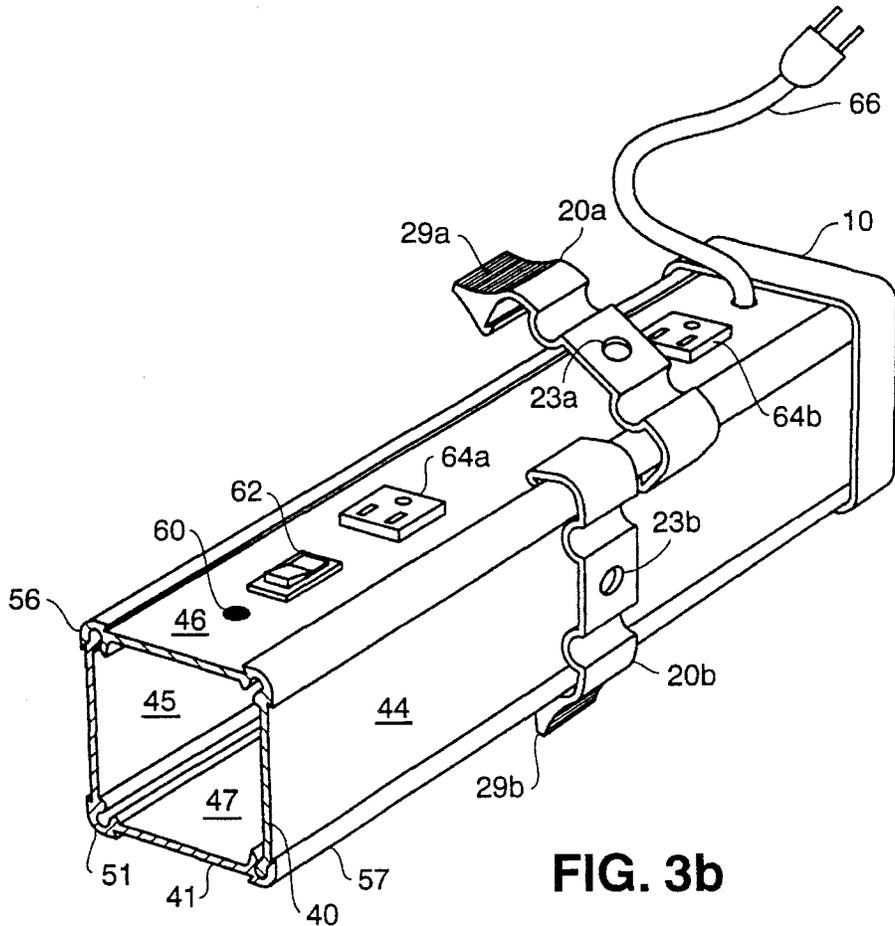


FIG. 3b

UNIVERSALLY MOUNTED POWER STRIP

REFERENCE TO RELATED APPLICATION

The present invention relates to assignee's co-pending application entitled Universal Rack Wire Management Panel, Ser. No. 08/251,513 filed May 31st, 1994.

FIELD OF INVENTION

The present invention relates to electronic cabinet mounting and wiring apparatus. More specifically, the present invention relates to power strips adapted for mounting within an electronic cabinet or an electronic relay rack.

BACKGROUND OF THE INVENTION

Electronic cabinets have been used for sometime to house and support electronic modules. Each cabinet has four horizontal frame members generally attached in the shape of a square defining a cabinet top, another four horizontal frame members defining a bottom, and two left and two right vertical frames members extending vertically along the four corners of the cabinet between respective top and bottom corners and defining a front, back, left side and right side of the cabinet. The top, bottom and side skeletal frame members may or may not support sheet metal panels including a top panel, bottom panel, left side panel, right side panel, front panel and back panel all of which serve to enclose the interior space of the cabinet. The front and back panel may or may not include a door for access to the interior of the cabinet defined by all of the panels. The left side of the cabinet is defined by the two left vertical cabinet frame members and the right side of the cabinet is defined by the two right vertical cabinet frame members. Between the two left vertical cabinet frame members and also between the two right vertical cabinet frame members are horizontally positioned struts which strengthen the frame of the cabinet and which are used to support electronic racks. The cabinet may house one or two electronic racks each having a vertically extending left supporting frame member and a vertically extending right supporting frame member both of which have a vertically extending row of mounting holes for receiving mounting screws for mounting electronic modules horizontally between the left and right rack supporting frame members, as is well known. Standard size electronic racks have standard width and height dimensions and have standard mounting holes that have become universally accepted. One standard size electronic rack, among many, is the standard, rectangular frame, EIA electronic relay rack. The standard relay rack provides a standard width of nineteen inches, and is commonly referred to as the nineteen inch relay rack, but may also be manufactured in a variety of widths, including the standard twenty-three inch version. The standard size relay rack is also manufactured with a standard height of seven feet, but may also be manufactured in a variety of heights, including standard four, six and eight feet heights. The mounting holes are spaced apart to provide for a maximum number, typically forty-two, electronic rack module positions vertically along the height of the rack.

The cabinet may include one or two electronic racks each of which is defined by opposing left and right vertical frame members between which extend horizontally mounted electronic modules. Each left and each right electronic rack vertical frame member is rigidly attached to respective left and right horizontal struts. Each vertically extending rack

flanges with several screw supporting holes for screw attachment to respective nuts placed within the struts. Each strut is generally in the form of an elongated rectangular bar having an elongated rectangular cavity. One elongated side of each strut has an elongated slot which extends the length of the strut and faces the interior of the cabinet. The rectangular cavity receives nuts which may be slidably positioned anywhere along the length of the rectangular cavity. The horizontal elongated extending slot of a strut is used to receive supporting screws from the orthogonally extending flange supporting holes of the rack frame. The supporting screws from the rack are screwed into and fastened to the nuts retained within the rectangular cavity of the struts to secure the rack to struts of the cabinet. Thus, the strut retains nuts which are fastened to supporting screws which may be fastened in respective supporting holes of the orthogonal flanges of an electronic rack to thereby secure the racks to the struts within the cabinet. Each strut also has two opposing ends which are attached to either the two left or two right vertically extending cabinet frame members on each side of the cabinet.

In a typical configuration, the cabinet may have a front rack, a back rack, left and right lower struts positioned near the bottom on the cabinet, left and right middle struts and left and right top struts positioned near the top of the cabinet. Thus, a cabinet can have one or more racks each having a left and right vertically extending frame member attached to one or more left and right struts and supporting a plurality of electronic modules, as is well known. The electronic racks support the electronic modules each of which typically having a power cord through which power is supplied. There has existed from some the need to route electrical power within the cabinets and more particularly to supply power to various electronic modules supported within the cabinets and more particularly mounted on the vertically extending rack frames.

Various means have been employed to conveniently route power cables within the cabinets to distribute power throughout an electronic rack within the cabinet. Cable routers of a variety of types have been used in cabinets to route wires. One such router is the Universal Wire Management Panel of the referenced related application. The wire panel has a plurality of parallel spaced slit rings through which wires are routed and to which are integrally attached rods onto which are attached clips which are used to clip the wire panel to the rack vertical frame members. Each clip has a screw hole through which a screw fastens the clip to the vertical rack frame members. The wire panel can be clipped and fastened either vertically along a rack frame or horizontally between to opposing rack frames.

Additionally, the vertically extending rack frame members and the horizontally extending struts provide stable structures onto which may be positioned electrical distributing devices, such as power strips having one or more electrical outlets, typically of the three socket variety for receiving common two or three prong electrical plugs, or for receiving two or three prong transformers both of which having respective electrical cords extending to the electronic modules.

The power strips are generally elongated rectangular strips having a square cross section and ends between which are positioned the power outlets disposed on one of the four elongated sides. The power strips may be manufactured by well known aluminum extrusion processes in a variety of lengths. For examples, two feet, four feet and six feet industrial power strips have from eight to twenty outlets.

struction of either a dual U design or a flat U design. The dual U design has two U shaped elongated opposing pieces positioned facing each other forming a square cross section and connected together by a lip and groove pressure fit. The flat U design has a bottom U shaped elongated piece covered by a substantially flat piece positioned on top the bottom U shaped piece also forming a square cross section and also connected together by the lip and groove friction pressure fit.

These power strips are provided in a variety of lengths supporting a respective plurality of power outlets. The electronic modules typically have respective power cords with end three prong plugs which are routed to the power strips and more particularly to the outlets and inserted therein to route and supply power to the electronic modules. Each power strip typically has one standard three prong power cord extending external to the cabinet to an external power source and has a plurality of power outlets to route power to a plurality of respective electronic modules each having a respective power cord. Each power strip may contain a variety of electronic devices and circuits to enhance the distribution of electrical power through the power outlets. For examples, the power strips may contain a on-off switch for connecting power to all of the outlets or plurality of on-off switches for respectively connecting power to respective outlets. For other examples, the power strips may also contain circuit breakers, fuses, power taps, EMI filters, transient voltage surge suppressors, and indicator power on-off lamps. These electronic components including the outlets are positioned on or within the elongated housing of the power strip. The power strip may also have internal grooves extending along the power strip and used to support circuit boards which may support internally positioned power strip electronics. The power strips have provided many useful electrical power distribution functions and are supported in a variety of positions within the electronic cabinets.

Typically two substantially square plastic end caps are positioned at the end of the power strip to enclose the cavity of the elongated power strip and to improve the structural strength of the power strips. The end caps may have a recess for receiving a double D shaped circuit breaker. The end caps also have screw holes receiving screws which are screwed into receiving bulbous grooves usually formed at all four corners of the extruded aluminum housing U shaped of flat shaped pieces. The power strip relies substantially in part upon the end cap screws to secure the two housing pieces together in addition to the lip and groove pressure friction fit running along the length on both sides of the power strips.

The power strips are typically rigidly attached within the cabinet. A rack mounted power strip is nineteen inches in length with end mounting holes at both ends for horizontal positioning on the electronic rack and for distributing power to the electronic modules on the rack. The power strips can also be attached vertically along the length of either the left or right vertically extending rack frame members. Further still, a power strip can also be attached horizontally along the length of a cabinet strut or attached vertically between two struts on one side of the cabinet. Power strip clips have been used to rigidly attach power strips to the rack frame members and to cabinets struts. The clips are generally flat square shaped pieces each with a center screw hole and with two opposing flanges which are pressure fit into power strip receiving flanges extending along the length of the bottom of the power strips. The power strip receiving flanges extend along the length of the bottom side of the power strip opposing the top side supporting the power outlets. There is a space between the bottom side of the power strip and the

clip hole for receiving a bolt head or nut for attachment to the rack frame members or to the struts.

One problem associated with the dual U shaped or flat U shaped design is the tendency on the two elongate pieces to separate from each other at the lip and groove friction fit when pulling a power plug out of one of the outlets. Another problem associated with the dual U shaped or flat U shape design is the reliance upon the use of the end caps and end cap screws to secure the two housing pieces together. The end caps positioned at the end of the housing do not substantially prevent the separation of the housing pieces due to the tendency of the housing pieces to bend and spring apart during removal of the power cord plugs, even though the end cap tend to keep the two housing pieces in relative longitudinal alignment so that the two pieces do not slide longitudinally against each other during use.

Another problem of the dual U shaped or flat U shaped design using the bottom receiving flanges and substantially flat power strip clips is the limited use of those flat power strip clips which to serve to position the power strip in only one position relative to the placement of clip within a cabinet. The power strip clips are positioned along only the bottom side of the power strip to disadvantageously limit the positioning of the outlets to only one position relative to the placement of the power strip clips. The power outlets always face away from the clips.

Yet another problem of the dual U shaped or flat U shaped design using the bottom receiving flanges is the limited number of power strips positions available within the cabinet. With the use of the bottom receiving flanges and the substantially flat power clips vertically attached to a rack frame member, the outlets of the power strip disadvantageously faces either towards the front when positioned on the front side of a vertically extending rack frame member or towards the back when positioned on the back side of a vertically extending rack frame member. With the use of the bottom receiving flanges and the substantially flat power clips horizontally attached between two rack frame members, the power strip disadvantageously faces either towards the front when position on the front side of the vertically extending rack frame members or towards the back when positioned on the back side of a vertically extending rack frame members. With the use of the bottom receiving flanges and the substantially flat power clips horizontally attached along the length of a horizontal strut, the power strip disadvantageously faces only towards the interior of the cabinet. With the use of the bottom receiving flanges and the substantially flat power clips vertically attached between two struts, the power strip disadvantageously faces only towards the interior of the cabinet. The routing of power wires and the placement of power strips have disadvantageously limited those individuals configuring the internal cabinet wiring who would otherwise prefer to have as many wiring options as possible. For example, transformers in the power strips facing the front rather than the side may be inadvertently bumped by operators and interrupting power to the electronic modules. Furthermore, power cords may not be easily routed away from operator exposure if the power strips are limited to a few available positions. These and other disadvantages are solved or reduced using the present invention.

SUMMARY OF THE INVENTION

An object of the present invention is to enhance the structural strength of power strips

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