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(71) **Applicant**: **MOLEX INCORPORATED** [US/US]; 2222 Wellington Court, Lisle, Illinois 60532 (US).

(72) **Inventors**: **BAINES, Elliot A.**; Molex Incorporated, 2222 Wellington Court, Lisle, Illinois 60532 (US). **SCHNEIDER, Gene**; Molex Incorporated, 2222 Wellington Court, Lisle, Illinois 60532 (US). **FREDERIKSEN, Bjarne**; Molex Incorporated, 2222 Wellington Court, Lisle, Illinois 60532 (US). **RIVERS, Philip**; Molex Incorporated, 2222 Wellington Court, Lisle, Illinois 60532 (US). **PANELLA, Augusto**; Molex Incorporated, 2222 Wellington Court, Lisle, Illinois 60532 (US).

(74) **Agent**: **JACOBS, Jeffrey K.**; Molex Incorporated, 2222 Wellington Court, Lisle, Illinois 60532 (US).

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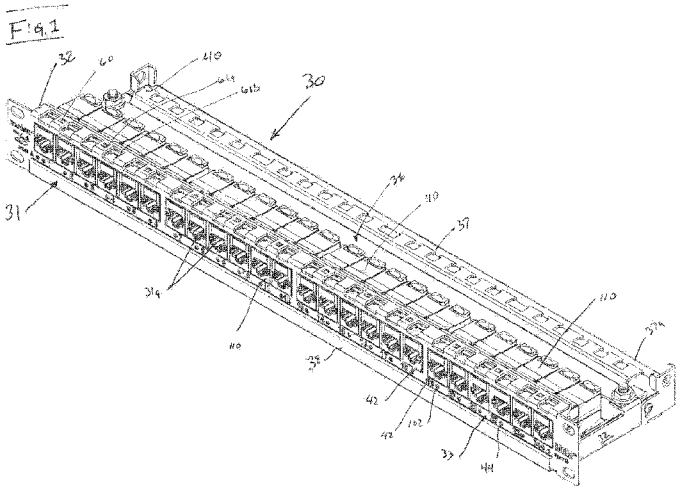
(54) **Title**: PATCH PANEL FRAME FOR CIRCUIT BOARD MODULE



(57) **Abstract**: An improved patch panel assembly includes a frame and faceplate that mate with a housing, and the housing defines a plurality of individual communication ports. The housing is mounted to the patch panel frame and includes jack openings that accommodate data jacks and circuit board openings that accommodate mating blades of circuit boards. The two sets of openings are separated on the housing by an intervening spacing and interposer terminal sets are provided to electrically interconnect the jacks with circuits on the circuit boards. The patch panel housings may be formed in discrete groupings so that, if desired, the patch panels may have ports that are grouped together by bandwidth, storage capability and the like. Inasmuch as the housings are mounted to the patch panel frames, the jacks and the circuit boards can be easily and individually replaced, repaired or upgraded with similar components without requiring disassembly of the patch panel.

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PATCH PANEL FRAME FOR CIRCUIT BOARD MODULE

Related Cases

[0001] This application claims priority to United States Provisional Application No. 62/033965, filed August 6, 2014, which is incorporated herein by reference in its entirety.

Background Of The Present Disclosure

[0002] The Present Disclosure relates, generally, to structures utilized in data transmission networks, and, more particularly, to network panel assemblies, jacks for such assemblies, housings for holding such jacks in place within such assemblies, and light pipe arrangements for such assemblies all having improved structures that facilitate quick and reliable upgrading and assembly of data transmission networks.

[0003] Data transmission networks are widely used in business operations, including financial, retail, manufacturing, medical, education and engineering sectors. They typically are comprised of a central server or computer storage unit that is linked, or networked, to a plurality of end user devices. Such end user devices include any device that transmits or receives data, such as personal computers, docking stations, wireless transmitting facilities, while end user devices may include printers, scanners, facsimile machines and voice over internet phones and Internet Protocol- (IP-) enabled sensors, alarms, cameras and lighting systems. All of these devices are usually operatively linked, or connected together, by means of data transmission lines that utilize high speed data cables containing associated pairs of high speed data wires.

[0004] A company or enterprise may include numerous end-user devices, deployed throughout an office campus or building in individual offices and/or in common areas accessible to the network end-users, such as conference rooms, Wi-Fi areas and printer havens. The network devices in the form of switches and routers form the heart of an enterprise data communication network as they route data packets between end-user devices on local area networks or between the local area network and larger corporate wide area networks, as well as the Internet. Many of these routers and switch network devices are typically located in rooms known as wiring closets and in data centers. In order to provide connections between the various end-user devices, the network devices are interconnected by cables in a one to one relationship. Cables may be used to connect data transmission lines to routers and switches which direct the data signals to end-user devices.

[0005] A network often utilizes network panels as one means of interconnection and the network panels, typically called "patch panels," are interposed between the end user devices and switches or routers and may be used to connect the end user computers to internal networks or the Internet. Patch cords, or patch cables, are utilized to interconnect the various data transmission lines to the network devices. Space is at a premium in wiring closets and therefore it is advantageous to find ways to reduce the size of patch panel assemblies, or increase their capacities. Such patch panel assemblies may include a circuit board that is fixed in place within the panel assembly, a housing that is mounted to the circuit board and attached to a panel face and/or frame, and one or more data jacks that are held in the housing to define a plurality of panel ports, each of which accommodates a multi-wire jack. The wires of the data transmission cables running from the end user stations or devices are terminated to the back faces of the jacks of the panels, typically using a wire punch, onto insulation-displacement terminals. Patch cords are used to then connect the data transmission lines associated with one patch panel to ports (jack openings) of another network panel. Patch cords may be used in this manner to connect the data transmission lines to specific end user stations or devices.

[0006] Patch panels may be considered as the nerve center of an enterprise's information technology or data transmission system as they are the main links to connect data and route it to where it needs to go. Patch panels serve a central role in the administration of the telecommunications network in that they enable the process of moves, adds and changes of end user stations and devices. In today's complex office architecture, patch panels represent the only useful way to transfer lines from one office to another. For example, if two workers must transfer desk locations, a simple switch of patch cords into various ports on a patch panel can ease the move. Without this capability, much time and energy would be spent terminating cable that would have to be hard-wired. Patch panels are typically manufactured in standard widths and heights and a typical standard size patch panel includes 24 ports. These ports accommodate up to four wire pairs each for a total of 96 wire pairs. Those wire pairs are terminated to the termination face of the jacks by way of respective associated termination blocks, each of which supports a plurality of insulation displacement terminals. The data cables and their associated wires are supported on a frame at the rear of the panel and these cables tend to reduce the space available for manipulation of the cables. It is very time-consuming to change out patch panel components and the tight clearances associated with them make the changing, or upgrading, process difficult.

[0007] Changing or upgrading conventional patch panel assemblies is troublesome as the jacks may be mounted all together, as shown and described in U. S. Patent No. 8,251,707, issued 28 August 2012 to the assignee of the Present Disclosure, the content of which is hereby incorporated herein in its entirety, in an arrangement upon one side of a first circuit board and termination blocks for the jacks are mounted on the opposite side of the first circuit board. In this design a second circuit board is connected to the first circuit board and spaced apart therefrom in order to support electronic components that affect the data transmission to and from the ports. These first and second circuit boards are supported as an interconnected pair, along with operational indicators on the second circuit board that typically take the form of light-emitting diodes ("LEDs"). These two circuit boards, their jacks and termination blocks form an integrated assembly that supports the electronics required for all 24 ports of the patch panel. All of the relevant electronics are supported on these two circuit boards. If a user needs to repair an electronic component or replace either of the panels, requires that all 24 ports of the patch panel are taken out of operation.

[0008] Furthermore, replacement of one of the data jacks, or even an indicator LED, due to failure or upgrading requires that all the supporting circuit boards be disassembled so that the jack or LED in question may be accessed. This takes a longer time than desirable and the negative effect of structures such as these are that it becomes close to impossible to do panel upgrades efficiently as all the panel components must be removed to access a single jack or other components. The jacks are further supported by the first circuit board in a manner such that termination of the cable wires must be performed carefully so as not to apply any excessive punch down forces to the first circuit board. Additionally, with such a structure, a user must purchase all the components necessary for all 24 ports of the patch panel and cannot simply start with a few ports and subsequently increase the capability of the patch panel. This can weaken already thin budgets for an enterprise that seeks to increase its IT capability as it grows. The structures shown in the '707 patent are not modular and cannot be replaced in smaller, discrete groups. That is one disadvantage to a conventional patch panel assembly.

[0009] Another disadvantage to such conventional patch panel structures is, as noted above, where the data jacks and termination blocks are mounted directly to a first circuit board or a monolithic circuit board assembly, care must be taken and specialized tools may need to be used to properly effect the termination of the wires of the data cables in a manner not to unduly transfer termination forces to the first circuit board. Similarly, because the jacks are

affixed to the first circuit board, these conventional patch panel systems do not have any "pluggable" aspect to their jacks, where an installer can merely insert each jack individually into a housing, after terminating the cable wires to it, in order to repair, replace or upgrade the jack.

[0010] The circuit boards utilized on the aforementioned patch panels not only extend the entire width of the patch panel but they support components used for all of the ports of the panel. Failure of the components associated with one or more panel ports requires removal of the entire circuit board and usually replacement of it, as well. This is expensive when not all of the ports in the panel have failed or need attention. The known patch panel assemblies described above do not permit individual port repair or replacement insofar as the circuit boards and the electronic components mounted thereon are concerned. Consequentially, certain individuals would appreciate improvements to a patch panel assembly.

SUMMARY OF THE PRESENT DISCLOSURE

[0011] Accordingly, there is provided a patch panel assembly with an improved, modular structure and a replaceable circuit board and port jacks associated with each such group of ports which facilitates upgrading and repair of the patch panel.

[0012] Accordingly, there is provided a novel housing-style connector, or bezel for use with an associated patch panel, wherein the housing receives a plurality of data jacks in a pluggable fashion in one set of openings and receives circuit boards in another set of openings, in a manner so as to advantageously reduce the time required for upgrading or replacing portions of a patch panel. Further, there is provided a patch panel with an associated light pipe assembly that includes a housing supporting light pipes such that receiving ends thereof are aligned with LEDs supported on circuit board(s) which are insertable into openings of the circuit board.

[0013] Further, there is provided an improved data jack for use with patch panels having a structure that permits the jacks to be releasably mounted in a housing within the patch panel wherein the jacks have exterior terminals for connecting to circuits on an associated circuit board by way of interconnecting terminals supported on the housing. There is further provided an electronic module which may be easily inserted and removed from engagement with the patch panel assemblies of the Present Disclosure, wherein the module includes a circuit board supporting various electronic components which are required for monitoring

patch cord placement and the connectivity of the network, the module further including a cover plate and a base plate assembled together in a spaced apart fashion with a locking mechanism to hold the circuit board in place in engagement with the frame of the patch panel housing.

[0014] Accordingly, there is also provided a patch panel assembly that supports a face plate, one or more housings that engage the face plate with the housings including a plurality of data jack openings and a plurality of circuit board openings wherein the circuit board openings are disposed in the patch panel assembly beneath the jack openings, and the assembly having a cable manager that is maintained in a spacing from the rear of the face plate, wherein the cable manager and the jacks are maintained at a preselected level defining a nest underneath them so that modules containing circuit boards may be inserted and removed from the panel assembly as necessary without interferingly contacting jacks in the jack openings or cables terminated to the jacks.

[0015] In accordance with an embodiment as described in the following Present Disclosure, an improved patch panel assembly is provided that facilitates the upgrading, replacing and repair of the panel. The patch panel has a frame that supports a panel face plate that accommodates a plurality of ports. A plurality of housings, each housing configured to support a specific number of ports, is provided to fit into the patch panel frame. The housings include means for engaging the frame so as to fix the housings in alignment with the patch panel face plate. The housings preferably include a plurality of first and second openings. The first openings are aligned together along a first axis and the second openings are aligned together along a second axis. The first and second openings are spaced apart from each other and the first and second axes are preferably generally parallel to each other. The first openings of the housings accommodate individual jacks, while the second openings are dimensioned to accommodate mating ends of circuit boards. The first openings have vertical axes, while the second openings have horizontal axes.

[0016] The housings are preferably configured to accommodate a certain number of data jacks, such as 1, 2, 3, 4, 6, 8, 12 or 24 data jacks in their first openings. They include clips or tabs formed proximate to their first openings which extend into the openings in a manner to engage an opposing portion of the data jacks. The second openings preferably take the form of slots that are configured to receive mating blades of one or more printed circuit boards. In order to connect circuits of the circuit boards to the wires terminated to the jacks, the housing includes sets of terminals supported in an interposing fashion, so that the terminals have one

set of free ends that are aligned with contact pads on the circuit boards, the terminals further includes a second set of free ends which are aligned with terminals tail portions of the data jacks. The housing terminals are supported on the housing so that they are interposed between the data jacks and the circuit boards and the terminal tails have a preloaded spring structure that permits them to accommodate dimensional variations in the jacks and circuit boards. The housing first openings serve to align the jacks to the circuit boards in order to ensure reliable connections there between.

[0017] One or more circuit boards are also provided with electronic components utilized for data transmission and the circuit boards may be made in widths so that they match, in number, the number of associated second openings of the housings. In this regard, the patch panels of the Present Disclosure have a modular nature in that the housings and the circuit boards may be matched together by the number of jacks they accommodate. For example, a 24 port patch panel may include six housings that accommodate 4 jacks each and six circuit boards that engage respective single housings. Such a patch panel would be considered as having six individual modules. Likewise, if only three housings were provided accommodating 8 jacks each, then only 3 circuit boards would be required for that patch panel. The circuit boards contain mating blades at their ends which are inserted into the second openings of the housings. The other ends of the housing terminals ride along the surfaces of the circuit boards and make contact with circuits thereon by way on an array of contact pads.

[0018] The circuit boards used in the patch panel assemblies of the Present Disclosure are preferably held together in a module style format. That is, the circuit boards are held in enclosures between top and bottom cover members and spaced apart therefrom by way of standoffs or the like. The top and bottom cover member may be supported by a backing bar that extends for the width of the circuit board. The backing bar preferably has one or more engagement hooks associated with it that will engage opposing slots in the patch panel frame so that the circuit board modules may be effectively locked in place in their engagement with the patch panel frame and in their mating engagement with the patch panel housings. The backing bar serves as a handle for a user to insert and removes selected individual circuit boards from the patch panel assembly without the need for removing either other circuit boards or any of the jacks.

[0019] Alternatively and preferably, a single circuit board could be used in place of multiple circuit boards, spanning across multiple housings. Thus, if a user wishes to slowly build his

patch panel up to a full 24 port complement, he can begin by purchasing and installing one module comprising one housing, one circuit board and whatever number of jacks the housing may accommodate. When the user wishes to expand his patch panel, he can purchase one or more additional modules and, in effect, "plug" them into place without disconnecting the jacks which are already in place in the patch panel with previously installed modules. This structure permits quick upgrades insofar as adding additional jacks is concerned. If a user wants to upgrade his entire panel or one or more modules thereof, he can easily remove the existing jacks and circuit boards and replace them with upgraded jacks and circuit boards, without disassembling any significant portion of the patch panel assembly. Hence, the patch panel assemblies of the Present Disclosure provide for "smart" panels that are more efficient and less expensive to maintain and install.

[0020] In another embodiment of the Present Disclosure, an improved data jack is provided. The jack includes an exterior metal or plastic housing that defines a hollow interior in which a plurality of terminals and an insulative body portions are housed. The terminals engage an internal circuit board and circuits thereon that lead to insulation displacement terminals ("IDTs"), and these two sets of terminals preferably extend in opposite directions. The internal circuit board is preferably vertically oriented within the housing and provides an interconnection between the jack contact terminals and its IDT tail terminals. Advantageously, the internal circuit board also has a series of third, or exterior, terminals connected to it and these exterior terminals include tail portions that extend out from the jack body and outside the jack housing. The jacks have an integrated structure that permits cable wires to be terminated to them in an easy manner, using standard punch down tools.

[0021] The data jack housings are configured to be accommodated with the first openings of the housings, and the tail portions of the exterior terminals have free spring ends and are aligned with the housing interposer terminal one ends. In this manner, when the jacks are inserted into their assigned first openings, their exterior terminal tail portions will make contact with the interposer terminals of the housings and thereby connect to selected circuits on the circuit boards. The jacks further include one or more tabs or stops that define reaction surfaces of the jack which may be engaged by latch members which are formed in the housing first openings. The latch members are configured so they have contact surfaces on opposite sides so that a tool may be used from either the front or rear of the patch panel to release the latch from engagement with the jack and free the jacks from the housing first openings. In this manner, the jacks are releaseably held in place in the housing first openings

in a secure manner so that releasing the engagement between the jacks and the housing is easily effected by use of a screwdriver or other bladed tool. The jacks may also be upgraded, replaced or repaired in the field without having to re-cable the patch panel assembly.

[0022] The patch panel is provided with grounding clips to ensure a reliable grounding contact among the jacks and the patch panel faceplate. The sidewalls of the housing first openings prevent substantial sideways movement of the jacks and the top and bottom walls of the openings prevent the jacks from working free in vertical directions. The jack housings may include one or more shoulder portions that confront and contact opposing surfaces on the housing to limit the extent to which the jacks may be inserted into the housing first openings. Internally, the jack may be provided as in another embodiment, with an insertion-activated switch that includes a terminal contact that extend upwardly at an angle within the opening of the jack and is pressed down into contact with another terminal contact when a plug is inserted into the jack opening. This provides a means of testing the connectivity and continuity of the particular port with which the jack is associated.

[0023] In still another embodiment of the Present Disclosure, the panel frame is constructed such that the housing maintains the jacks held in the housing jack opening at a distance above the circuit board openings. A cable manager which will support a series of network cables is provided that extends laterally with respect to the patch panel assembly and is maintained at an elevation equal to that of the jacks. The cable manager supports the jack cables, also at an elevation that it equal to that of the jacks. In this manner, a clearance is defined beneath the jacks, which defines a nest into which the circuit board module may be inserted or removed as desired. The nest accommodates the module in a manner such that replacement of modules can be effected without disturbing the jacks associated with the module.

[0024] In yet another embodiment of the Present Disclosure, a plurality of light pipes is provided extending between the circuit board and the front face plate of the patch panel. These light pipes are part of an overall status indicating system of the patch panel and are illuminated by way of LEDs disposed on the patch panel circuit boards. In order to conserve valuable space, the housings are provided with channels which are associated with each of the first openings. The channels extend lengthwise through a base of the housing and underneath both the first and second openings thereof. The light pipes have opposing receiving and transmitting ends. The receiving ends of the light pipes are aligned with LEDs positioned on the circuit boards, and preferably the bottom surface thereof. The transmitting ends are aligned with and may extend through openings in the patch panel face plate and

associated with particular ports thereof. The housing channels which accommodate the light pipes may communicate with the second openings so that the receiving ends of the light pipes may lie as flush against the LEDs as possible.

[0025] The transmitting ends of the light pipes extend underneath the housing in respective cavities aligned with the first openings. The light pipes may have offset configurations so that the transmitting ends thereof abut the bottom surfaces of the housing front cavities. In addition to the height of the housing second openings, the housing interposer terminal other ends preferably take the form of cantilevered spring arms that cooperatively exert and downward pressure on any circuit board inserted therein and this pressure assists in ensuring the light pipe receiving ends contact the circuit board LEDs. The LEDs and the light pipe input ends are arranged within the panel frame so that simple insertion of the circuit board modules into engagement with the patch panel frames will align them for abutting engagement.

[0026] These and other objects, features and advantages of the Present Disclosure will be clearly understood through a consideration of the following detailed description.

BRIEF DESCRIPTION OF THE FIGURES

[0027] The organization and manner of the structure and operation of the Present Disclosure, together with further objects and advantages thereof, may best be understood by reference to the following Detailed Description, taken in connection with the accompanying Figures, wherein like reference numerals identify like elements, and in which:

[0028] Figure 1 is a perspective view of a network panel incorporating improvements in accordance with the Present Disclosure;

[0029] Figure 2 is an exploded view of the network panel of Fig. 1;

[0030] Figure 3 is an exploded view of one bay of the network panel of Fig. 1;

[0031] Figure 4 is a front elevational view of the network panel of Fig. 3;

[0032] Figure 5 is a perspective view, taken from the rear, of the network panel bay of Fig. 3, but with the jacks removed for clarity;

[0033] Figure 6 is an exploded view of the network panel bay of Fig. 5;

[0034] Figure 7 is a rear elevational view of the network panel bay of Fig. 5, taken along Line 7-7 thereof;

[0035] Figure 8 is a front elevational view of the bezel member of the network panel bay of Fig. 5;

[0036] Figure 9 is a sectional view of the bezel member of Fig. 8, taken along Line 9-9 thereof;

[0037] Figure 10 is a side elevational view of a network panel bay, illustrating how a jack housing is inserted thereinto;

[0038] Figure 11 is a top plan view of a network panel bay without any jacks in place, and illustrating the network panel circuit board spaced apart from and in alignment with the bezel member;

[0039] Figure 12 is a bottom plan view of a portion of a circuit board used in the network panels assemblies of the Present Disclosure;

[0040] Figure 13 is an enlarged, detailed sectional view of a network panel bay illustrating a group of data jacks aligned for insertion into a corresponding housing member and further illustrating the housing interposed terminals that connect terminals of the jacks to contacts on the circuit board;

[0041] Figure 14 is a perspective view, taken from above of the network panel bay with its corresponding jacks installed;

[0042] Figure 15 is a partially exploded view of the network panel bay of Fig. 14;

[0043] Figure 16 is a perspective view, taken from a different angle of the network panel bay of Fig. 14;

[0044] Figure 17 is an enlarged detail, sectional view of the interconnection between a bezel member, jack and circuit board utilized in a network panel assembly of the Present Disclosure;

[0045] Figure 18 is a perspective view of a data jack utilized in network panel assemblies of the Present Disclosure;

[0046] Figure 19 is an exploded view of the jack of Fig. 18;

[0047] Figure 20 is a side elevational view of the exploded jack of Fig. 19;

[0048] Figure 21A is a perspective view of the interior assembly of the jack of Fig. 18;

[0049] Figure 21B is a side elevational view of the jack interior assembly of Fig. 21A;

[0050] Figure 22 is a perspective view of a patch panel circuit board module in accordance with the principles of the Present Disclosure, aligned with a patch panel frame and prior to insertion into and connection therewith;

[0051] Figure 22A is a sectional view of the circuit board module of Fig. 22 taken along Line A-A thereof;

[0052] Figure 23 is an exploded view of the circuit board module aligned with a patch panel frame with a housing mounted therein;

[0053] Figure 24A is a longitudinal sectional view of a patch panel frame and housing assembly;

[0054] Figure 24B is the same view as Fig. 24A, but with a circuit board module inserted into the frame nest; and

[0055] Figure 24C is the same view as Fig. 24B, but with a jack in place within the frame and portions of the circuit board module shown in phantom.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0056] While the Present Disclosure may be susceptible to embodiment in different forms, there is shown in the Figures, and will be described herein in detail, specific embodiments, with the understanding that the Present Disclosure is to be considered an exemplification of the principles of the Present Disclosure, and is not intended to limit the Present Disclosure to that as illustrated.

[0057] As such, references to a feature or aspect are intended to describe a feature or aspect of an example of the Present Disclosure, not to imply that every embodiment thereof must have the described feature or aspect. Furthermore, it should be noted that the description illustrates a number of features. While certain features have been combined together to illustrate potential system designs, those features may also be used in other combinations not expressly disclosed. Thus, the depicted combinations are not intended to be limiting, unless otherwise noted.

[0058] In the embodiments illustrated in the Figures, representations of directions such as up, down, left, right, front and rear, used for explaining the structure and movement of the various elements of the Present Disclosure, are not absolute, but relative. These representations are appropriate when the elements are in the position shown in the Figures. If

the description of the position of the elements changes, however, these representations are to be changed accordingly.

[0059] Many embodiments are described herein. For example, such embodiments include but certainly are not limited to: Patch Panel Assemblies with Modular Aspects, an Interconnecting Housing For Network Patch Panel, a Data Jack With Exterior Terminals, a Light Pipe Assembly For Network Patch Panels, a Patch Panel Frame With Module-Receiving Nest, and Circuit Board Modules For Use With Patch Panel Assemblies. General descriptions of these example embodiments follow as an introduction to their more detailed descriptions with reference to the Figures.

[0060] Patch Panel Assemblies with Modular Aspects: An improved patch panel assembly includes a frame and faceplate that mate with a housing, and the housing defines a plurality of individual communication ports. The housing is mounted to the patch panel frame and includes jack openings that accommodate data jacks and circuit board openings that accommodate mating blades of circuit boards. The two sets of openings are separated on the housing by an intervening spacing and interposer terminal sets are provided to electrically interconnect the jacks with circuits on the circuit boards. The patch panel housings may be formed in discrete groupings so that, if desired, the patch panels may have ports that are grouped together by bandwidth, storage capability and the like. Inasmuch as the housings are mounted to the patch panel frames, the jacks and the circuit boards can be easily and individually replaced, repaired or upgraded with similar components without requiring disassembly of the patch panel.

[0061] Interconnecting Housing For Network Patch Panel: A housing for housing and interconnecting components of a patch panel assembly includes a body portion with first openings that are configured to releasably receive data jacks therein, and second opening that are configured to receive mating blades of printed circuit boards. The first and second openings are aligned together in distinct rows so that the first and second openings are spaced apart from each other. In order to interconnect terminals of the data jacks with circuit on the circuit boards, a plurality of conductive terminals are provided and are supported by the housing body portion. The terminals are located between the first and second openings and the terminals include free ends that extend toward the openings so that insertion of the jacks and circuit boards causes the terminal free ends to contact same and electrically interconnect them together.

[0062] Data Jack With Exterior Terminals: An improved telecommunications jack is provided that reduces the time for repair, replacement and upgrading of network patch panel components. The jack includes an exterior metal housing in a configuration dimensioned to fit into a first opening of a housing of the patch panel. The jack housing includes one or more stop surfaces that are engaged by a latch member on the housing which extends into the first opening. The jack has an interior hollow cavity that accommodates a plurality of conductive terminals that mate with a data plug inserted into the jack. A flexible terminal is disposed in the jack cavity and flexes under pressure of an inserted plug to contact another terminal and signal that the plug is inserted. The jack further includes a plurality of terminals that extend outside of the housing and into contact with terminals supported by the patch panel housing.

[0063] Light Pipe Assembly For Network Patch Panels: A light pipe structure particularly useful with network patch panels includes at least one housing that defines a preselected number of communication ports of the panel. The housing has individual openings that receive individual data jacks and a common opening that receives one or more mating blades of a circuit board. Each housing has its board-receiving opening disposed beneath its set of jack openings and channels are provided in the housing that receive and support light pipes. The channels communicate with the broad-receiving openings so that the transmitting ends of the light pipes may confront light-emitting diodes mounted on the circuit boards, when the circuit boards are inserted into the board-receiving openings of the housing. The display ends of the light pipes may be arranged beneath individual panel ports.

[0064] Patch Panel Frame With Module-Receiving Nest: A patch panel assembly has a frame structure that includes a face plate, a base plate, a jack housing and a cable manager. The housing has first openings for jacks and second openings for circuit boards. The second opening are located beneath the first openings so that any one circuit board may be inserted or removed without necessitating removal of the remaining circuit boards. Additionally, the jacks are maintained at a certain level within the patch panel frame as are their associated cables, managed by a cable manager at a similar level above the base plate of the patch panel frame. This difference in elevation defines a nest that accommodates circuit board modules that may be inserted and removed in a pluggable fashion.

[0065] Circuit Board Modules For Use With Patch Panel Assemblies: A patch panel assembly has a frame structure that includes a face plate, a base plate, a jack housing and a cable manager. The housing has first openings for jacks and second openings for circuit boards. The circuit boards are supported within modules that include corresponding

engaging cover and base plates that define a modular enclosure. Standoffs support the circuit boards within the modules in an orientation such that they can easily be inserted and/or removed from the patch panel housing second openings.

[0066] Figs. 1-2 illustrate a patch panel assembly 30 constructed in accordance with the principles of the Present Disclosure having an improved structure which provides beneficial results when used in association with a data communication network. The patch panel assembly 30 includes a patch panel 31 comprising an elongated frame 32 having an associated elongated face plate 33 that extends widthwise along the frame. The panel frame 32 may include, as shown, a rearward extending base plate or portion 34 that defines a floor, or receptacle, which may receive a module assembly 36 therein. The face plate 33 and base plate 34 may be integrally formed together as illustrated, or may be separately formed and joined together in a conventional manner such as by screws, nuts, clips and the like.

[0067] The panel face plate 33 extends in two directions. The face plate 33 includes a front portion 33a that faces outwardly and which has port identifying characteristics such as numbers, symbols and the like, and a top portion 33b bent from the front portion 33a to extend rearwardly therefrom. The top portion 33b may also be considered as a retainer bar, or member, because it includes a plurality of stop surfaces and openings that are configured to engage complimentary shaped engagement members or panel housings 46, noted in more detail to follow.

[0068] A cable manager 40 is provided and it extends widthwise between mounting ends 32a of the patch panel frame 32, which may be bent inwardly, as illustrated, and may be secured thereto by nuts 32b on a mounting bolt 32c, as illustrated. The cable manager 40 is offset toward the rear of the patch panel assembly 30, as shown, and is preferably raised with respect to the panel 32 in order to define a widthwise space through which cables (not shown) connected to the jacks 110 may be run. The cable manager 40 has a serrated end configuration with a plurality of slots 41 formed therein for supporting cables which are terminated to the panel jacks 110. A circuit board module 36 is shown as rectangular in configuration and is provided that at least partially encloses a circuit board 86 associated with a particular section of the patch panel assembly 30. The circuit board module 36 includes a base plate or bottom cover 35, a top plate or cover member 35a and an end plate 37, which cooperatively define a hollow enclosure for the circuit board 86 utilized in assemblies of the Present Disclosure.

[0069] The end plate 37 closes the rear end of the module 36 and further can be configured to define a handle 37a by which a user can easily insert and remove the modules 36 from their position in the panel frame and engagement with the housing circuit board openings 56. The cover plate 35a extends over a portion of the circuit boards 86 utilized in the patch panel assemblies 30 and provides a means to protect the electronic components supported on and connected to the circuit board 86.

[0070] Standoffs 92 in the form of threaded tubes 92a (Fig. 22A) are provided to support the circuit board 86 above the base plate 35 and away from the cover plate 35a and may be used in conjunction with recesses 36b formed therein. Corresponding screws 93 engage the tubes 92a to orient the circuit board 86 properly within the module 36 at a height suitable for reliable engagement with the housings 46. The circuit board leading edge projects outwardly from the interior of the module 36 and it extends between and past the respective leading edges of the base and cover plates, 35, 35a and into alignment and engagement with the circuit board openings 56 of the panel housing 46.

[0071] The circuit board 86 of the patch panel assembly 30 is spaced apart from and above the base plate 34 of the 30, and may include not only electronic components 94a, such as amplifiers, logic gates, controllers and the like, but also one or more connectors 94b supported on the top and/or bottom surface 98 of the circuit board 86. The connectors 94b may extend as shown either vertically or horizontally, and accordingly, the cover plate 35a and end cap 37 are provided with openings or penetrations 35c, 37c that permit the receptacle portions of the connectors 94b to be accessed. As illustrated best in Figs. 11 and 16, these connectors 94b provide a means to connect to the circuitry of the circuit board 86.

[0072] Although illustrated in the Figures as a single circuit board 86, it will be understood that the structure for the patch panel assemblies of the Present Disclosure will permit the use of multiple circuit boards, depending on the system designer's needs. In such instances, multiple circuit boards may be associated with single or multiple panel housings 46. Such a structure will permit an incremental, "drop-in" expansion with the system operator being able to insert additional circuit boards 86 to increase system capacity or the like, rather than remove and replace a single circuit board. Such multiple circuit boards may be associated with respective single panel housings 46, or they may be associated with a plurality of them such as two, or three, panel housings 46.

[0073] Due to the differences on lengths of the circuit board 86 and the top and bottom covers 35, 35a, the metal cover plate 35 of the module 36 does not cover all the electronic components 94a supported by the circuit board 86, so a protective covering in the form of a Mylar film sheet 95, or a similar film-type covering is provided as a cover as illustrated in Figs. 14-6. The leading edge 95a of the film sheet may be bent downwardly to define a contact flap 95b interposed between the electronic components 94a of the circuit board 86 and the terminals 63 of the panel housing 46 and so provide a measure of insulation against unintended shorting (Figs. 10-1 and 24C). The bottom cover plate 35 may include, as shown in Figs. 22A and 24C, an upturned stop surface 35b which prevents overtravel of the module 36 during insertion. It is formed by bending the front portion of the bottom cover 35 upwardly in order to confront opposing surfaces of the insulative portions of the panel housings 46. The height of these stop surfaces 35b is chosen to engage (if over-inserted) the insulative body portions of the panel housings 46 rather than contact the conductive terminals 63 supported on the housings 46.

[0074] The cable manager 40 is offset in the vertical direction to define a working space behind it and underneath the slots 41 thereof for cables to run, widthwise. The cable manager 40 is further spaced a preselected height above the panel frame base plate 34 to define a nest 108 within the panel frame 32 that accommodates the module 36. This nest also includes the vertical distance NH between the top surface of the panel frame base plate 35 and the bottoms of the jacks 110 and the bottom of the cable manager support base 40a (Fig. 7). This distance is greater than the height of the circuit board modules 36 and thereby permits the modules 36 to be inserted and removed from the patch panel 31 without interfering or disturbing any of the jacks110 or any part of the patch panel frame 32. The module 36 fits into the panel frame nest 108 in a sliding manner sliding upon the panel frame base plate 34. The module 36 also preferably includes means by which to engage the panel frame and as shown in the Figures, may include engagement ends 39 which may be integrally formed as side ends of the end cap 37 of the module 36. These engagement ends 39 include hooks 39a defined therein which are oriented lengthwise. They are disposed in opposition to corresponding opposing slots 34a formed in the panel frame base plate 34. The hooks 39a have planar stop surfaces 39b that engage confronting stop surfaces 34b of the base plate openings 34a.

[0075] In order to provide grounding contact, the circuit board modules 36 are also provided with grounding springs 36a that extend lengthwise along the side walls of the panel frame 32. As illustrated in Fig. 23, the grounding springs 36a are elongated and extend lengthwise.

They include two portions 36c that bow outwardly and make contact with the panel frame 32 inside walls. These grounding springs 36a will also make contact with each other as between adjacent modules 36. The modules 36 may have side walls along opposite sides thereof as illustrated in Figs. 1-2 and the rear end caps 37, associated end caps 37a and cable managers 40 extend between the sides. The right side walls, with reference looking forwardly, are not shown in Figs. 3, 5-6, 11 and 22-3 for clarity.

[0076] The panel frame 32, as shown best in Fig. 2, includes a plurality of openings, shown as rectangular slots 42, which extend widthwise within the face plate 33. These slots are configured to accommodate one or more housings 46, which serve to divide the openings 42 into distinct sets of individual patch panel ports 31a, each of which is configured to receive the plug end of a network cable (not shown). In this regard, the housings 46 may be particularly provided in sizes that define N number of patch panel ports, where N can typically be chosen from the group of 1, 2, 3, 4, 6, 8, 12 or 24. These numbers divide evenly into the standard number of ports in a patch panel, namely twenty-four. As such, if the patch panel face plate 33 is provided with four slot openings 42, the housings 46 that mate with the openings 42 will contain six first openings 55 that will form ports 31a in each slot opening 42. Likewise, six slot openings 42 will accommodate four first openings 55 in each housing 46.

[0077] The face plate 33 may further include a plurality of other ancillary openings, with one type of opening 43 accommodating mounting screws 43a that extend through the face plate and which are received in complementary screw openings formed in the housings 46. Other types of openings 44 may be dedicated as indicator openings which accommodate the output ends of light pipes 102 that display an indication of the status of the port 31a and/or a data transmission channel of the network. Other openings may be present that engage clips which hold a cover plate 38 in place over the housing screws. The face plate top retainer bar 33b extends back from the top of the face plate 33 and includes different openings 61a, 61b that will engage different parts of the housings 46 when the panel components are fully assembled.

[0078] In order to provide the patch panel assemblies 30 of the Present Disclosure with a measure of modularity, which reduces the time for paneling, repairing and assembling patch panels of the Present Disclosure, the face plate slots 42 have predetermined widths which accommodate a preselected number N of ports 31a of the patch panel 31. Housings 46 are provided which engage these slots 42 and the housings 46 not only serve to subdivide the

face panel slots 42 into individual patch panel ports 31a, but also provide a structure which accommodates and interconnects the jacks 110 and circuit boards 86 used in the patch panel assemblies 30 together.

[0079] Every housing 46 has a body portion 50, preferably formed from an insulative material. The housing body portion 50 has screw bosses 47 that are threaded and which permit the housing 46 to be attached to the patch panel face plate 33 by way of interengaging screws 48 and nuts 49. A plurality of vertical side walls 52 are supported on the housing body portion 50 and cooperatively define a plurality of hollow, first openings 55 which are configured to receive data jacks 110 therein. A top cross bar 54 extends widthwise and engages portions of the face plate retainer bar 54. Second openings 56 are provided in the housing 46 which accommodate the leading edges 87 of an associated circuit board 86. These second openings 56, as illustrated, extend for the most part horizontally as compared to the vertical directions in which the first openings 55 extend. If imaginary lines I1, I2, were drawn through the centers of the first and second openings, they would intersect each other as illustrated in Fig. 7. The jack openings 55 are aligned along a first common axis A1 which may be taken through the centers thereof, while the circuit board openings 56 may be aligned along a second common axis A2 which is also preferably taken through the centers thereof. These two axes are preferably parallel to the frame base plate 34.

[0080] The second openings 56 may be subdivided into pairs of openings 56a, 56b by means of a divider 58. This divider 58 takes the form of an upright wall and confronts a slot 91formed in the circuit board mating blade 89 to thereby provide a polarization aspect to the housing and circuit board combination so that a circuit board 86 may be inserted into the second openings 56 in only one (and correct) way. As shown in Fig. 5, grounding clips 46a may be provided for the patch panel housings 46 that extend into the first openings 55 of the housings to establish redundant grounding contact between the panel frame 32, the face plate 33 and the jacks 110.

[0081] The cross bar 54 of the face plate 33 includes different sets of openings 61, with one set, shown as square openings 61a, being configured to receive positioning studs 60 formed on the housing top bar 54. Other, rectangular openings 61b extend in an axial direction (front to back) in order to accommodate latch members 72 of the housing 46. The latch members 72 are cantilevered in their structure to define free ends 73, and they are shown as extending rearwardly in the embodiments discussed herein. If desired, the latch members 72 may be fashioned to extend forwardly. The cantilevered structure of the latch members provides

them with sufficient flexibility to selectively engage and disengage the jacks 110. The latch members 72 extend axially within these other openings 61b so that they may be manipulated from either the front of back of the patch panel face plate 33 in order to disengage them from the jacks 110.

[0082] The latch member free ends 73, as shown in Figs. 9-10, have angled surfaces 74a that permit the latch members 72 to slide up and catches 125 which are preferably formed as part of the front cover 124 of the jack 110 and which are disposed on the top surface of the jack 110. These catches 125 also have angled surfaces 125a as their front surfaces which facilitate the lifting of the latch member free ends 73 over the catches 125. The catches 125 further include rear stop surfaces 125b that are preferably planar surfaces that extend vertically. These rear stop surfaces 125b confront and engage the planar, hook surfaces 74b of the latch member free ends 74 to prevent the jacks 110 from falling out of their position within and engagement with the housings 46. The front faces of the latch members 72 may include a slot 75 or similarly configured element that permits a user to insert a tool, such as a screwdriver, into the patch panel retainer bar other openings 61b and engage the latch member 72. In this manner, the user can lift the latch member 72 up so that the hook surface 74b disengages the jack catches 125 and the jacks 110 may be withdrawn from the housing first openings 55.

[0083] Although the jack catch-latch member hook surface combination provides sufficient retention of the jacks 110 in place in the housing 46, in order to provide additional securement, the housing 46 may further include slots 77 that extend horizontally and which are disposed in the sidewalls 52 of the housing 46. These side wall slots 77 are configured to accommodate opposing locating ribs 133 that are disposed on the sides of the jacks 110 and which are illustrated as projecting outwardly from the jack front cover 124. The interengaging slot 77-locating ribs 133 combination provide a measure of retention to each jack to keep it in engagement with its housing openings 55. Additional structural features of the housings 46 that provide means for locating the jacks 110 in place within the housing 46 include shoulders 76 on the rear surfaces of the housing sidewalls 52. These shoulders 76 confront and engage opposing, vertical stop shoulders 132 that are disposed on the jack front covers 124.

[0084] In order to seat the housings 46 in a preferred orientation within the patch panel slots 42, the housing 46 may include an upraised edge 59 which may either be continuous for the width of the housings 46, or, as illustrated , it may have a discontinuous configuration. The

edge 59 bears against the rear edge of the top bar 33b of the panel face plate 33. The housing top edge 59 is also preferably spaced apart from the studs 60 of the housing and the latch members 72 so as to hold, preferably in an interference fit, the end of the face plate retainer bar 33b therebetween. This fit is illustrated at least in Figs. 10 and 14-5.

[0085] In an important aspect of the Present Disclosure, the housings 46 of the patch panel assemblies 30 are provided with a plurality of conductive terminals 63, which are preferably arranged in distinct terminal sets 62, with each terminal set 62 being associated with one of the housing first openings 55. For each set, the terminals 63 include central retention portions 64 which may include engagement barbs that are flanked by first and second terminal tails, 65 and 66, respectively. The tails 65, 66 extend away from opposite ends of the retention portions 64 in a cantilevered fashion ad extend outwardly away therefrom in an angled fashion such that imaginary lines drawn through the longitudinal axes of the terminal tails 65, 66 will intersect at a location rearwardly of the retention portions 64. In order to provide improved contact, the terminal first tails 65 may include different sized contact pads 65a.

[0086] The terminals 63 are supported by the housings 46 so that they are interposed between circuit in the data jacks 110 and circuits on the circuit board 86. The terminals serve to provide an electrical connection between exterior terminals 138 of the jacks 110 and contact pads 90 of the circuit boards 86. Due to their cantilever and overall bowed configuration, the terminals 63 are in effect, preloaded with a spring force so that they will resist any vertical forces applied to them and ensure reliable contact between the terminals 63 and the opposing elements. In this regard, and as illustrated in Figs. 10, 13 and 15-7, the terminal first tails 65 are aligned with respective housing first openings 55 and the terminal second tails 66 are aligned with the housing second openings 56 and further extend into the second openings 56.

[0087] The terminals 63 are positioned on the housing 46 firstly in an arrangement so that the second terminal tails 66 extend into the housing second opening 56 and align with corresponding contact pads 90 that are disposed on the top surfaces 96 of the circuit board 86 and which are disposed along the leading edges 87 thereof. The contact pads 90 are further arranged on the mating blades 89 of the circuit board 86, which may be separated from each other by the circuit board leading edge locating slot 91 that engages the housing second opening dividing wall 58. The terminal second tails 66 are preferable curved and the free ends thereof point generally forwardly so that the circuit board contact pads 90 will encounter the contact areas of the second tails 66, particularly the curved contact portions thereof when

the mating blades 89 or leading edges 87 of the circuit board is fully inserted into the second openings 56.

[0088] The terminal first tails 65 are formed with a similar configuration and include an elongated curved tail portion with a free end that extends forwardly toward the housing first opening 55. The curved portions of these first tails 65 may include, as illustrated, a series of contact portions 65a that have a width which is wider than most of the first tails 65. These curved contact portions 65a are positioned on the housing 46 in opposition to the exterior terminals 138 of the jacks 110. Their cantilevered structure permits them to flex under contact with the jacks 110 when the jacks are inserted into the housing first openings 55. In order to permit the terminal first tails 65 to fully flex under the pressure of the jacks 110, the housing body portions 50 preferably include longitudinal slots 53 disposed therein in alignment with the first terminals 65. These slots 53 receive the free ends of the terminal first tails 65, which deflect downwardly toward the terminal second ends 66 when the jacks 110 are inserted into the housing first openings. In this manner, the terminals 63 are held in the housing 46, which serves as both a support for the jacks 110 and circuit boards 86 and an interposer connector that electrically connects them together.

[0089] Patch panels often include light pipes for operational status information associated with their ports 31a. The circuit boards 86 utilized in the Present Disclosure have on their bottom surfaces 98, LEDs 100 mounted in supports 101 that support at a preselected level with respect to the circuit board bottom surfaces 98. The LEDs 100 and the light-emitting surfaces thereof are oriented with respect to the circuit board 86 and forwardly with respect to the patch panel 31. The housings 46 may be configured as shown best in Figs. 10 and 13-4, to support a plurality of light pipes 102 in a preselected association with the ports 31a of the patch panel 31.

[0090] The light pipes 102, as illustrated, have an offset and somewhat S-shaped configuration that extends between two ends, one end being an input end 105 which confronts, and preferably abuts the display faces 100a of the LEDs 100, and the other end being an output end 106. As noted above, the circuit boards 86 are supported in their modules 36 at a level so that the LEDs 100 thereof will abut the light pipe input ends 105 when the circuit board modules 36 are inserted into the panel frame nest 108. The output ends 106 extend into respective associated indicator openings 44 that are disposed in the patch panel face plate 33 in association with a patch panel port. The output end 106 can then

communicate with the exterior of the patch panel 30 to identify to an installer, user, technician or the like, operational status, for example.

[0091] The offset configuration of the light pipes 102 enable the input ends 105 thereof to be positioned within the patch panel assemblies 30 at a location below the level of the output ends 106. The housings 46 include individual channels 80 that are disposed in the body portions 50 thereof, and as illustrated in Fig. 13, the channels 80 may include a rear half 81 in the form of a tail slot, which is shown as a rectangular or square portion, that communicates with the second openings 56 of the housing 46. The channels 80 further include a front half 82, which also may take the form of square or rectangular channels in which the S-bend portions of the light pipes 102 extend. Although not shown, the housing body portions 50 may include depressions formed in the bottom surfaces 50a of the body portions 50 that engage portions of the outer surfaces of the light pipes 102.

[0092] The rear portions of the light pipes 102 that form the input ends 105 of the light pipes are square or rectangular in configuration which matches that of the channels rear halves 81, while the light pipe front portions that define the light pipe output ends 106 are generally cylindrical in configuration, particularly to fit into the face plate indicator openings 44. The LEDs 100 and their supports 101 depend downwardly from the bottom surfaces 98 of the circuit boards 86 and are preferably configured to fit in at least a portion of the rear channel halves 81. In this manner, the LEDs 100 may be placed into confronting and preferably abutting contact with the light pipe input ends 105. The light pipes 102 may illuminate and thereupon indicate the status of individual ports 31a, such as by color, or operation of the ports 31a in transmitting data.

[0093] It can be seen that the housings 46 serve to divide the patch panel assembly 30 and its associated face plate openings 42 into discrete groups of ports 31a, where each such port includes a jack opening of a housing, a data jack 110 inserted therein and a cable terminated to the jack. The number of ports 31a defined by each housing 46 can be chosen by the designer. As noted above, the number of ports 31a associated with each of the housings 46 in a patch panel assembly of the Present Disclosure will be chosen from the group of 1, 2, 3, 4, 6, 8, 12 or 24. This variety gives the end user the ability to utilize high-speed and low-speed ports in the same patch panel. It further increases the efficiency of repair, replacement or upgrading of the electronics associated with particular ports, or groups of ports 31a. Still further it permits an end user the ability to easily build his network, by equipping patch panels with only the housings to define all of the ports, but purchasing and installing an initial

number of jacks and associated circuit board or boards with which to start. Then the end user may add additional circuit boards and jacks to second, third and subsequent housing. This saves on initial start-up costs.

[0094] Likewise, patch panels of the Present Disclosure may be upgraded in such a step-wise fashion. The patch panels of the '707 Patent described above, required time consuming removal of the two circuit boards for upgrading, repair and replacement, resulting in serious downtime of the patch panel. Patch panel assemblies of the Present Disclosure eliminate this disadvantage. The jacks 110 of the Present Disclosure are also uniquely insertable and removable so that if repair, replacement or upgrading of the jacks must occur, it can be done to the jacks individually, without necessitating the removal of the circuit boards of any of the components associated therewith.

[0095] Turning now to Figs. 13 and17-22, a data jack 110 constructed in accordance with the principles of the Present Disclosure is seen to have front and rear interengaging covers 124, 126, respectively, which cooperatively define a jack housing that accommodates the internal structure of the jack 110 and which includes a rear opening 127 that accommodate the termination end of a multi-wire cable (not shown) in the jack housing. The jack front cover 124 includes a pair of catches, or stops 130 that are engaged by elongated hook portions 129 that are formed as part of the jack rear cover 126. As noted above, the jack 110 includes one or more catches 125 that are disposed on a top surface of the jack 110, and in the drawings, the catches 125 are illustrated in position on the jack front cover 124. A cable clamp 128, which may be spring-biased is mounted within the rear jack cover 126 proximate to the rear opening 127 to hold the cable in place with respect to the jack 110.

[0096] The internal components of the jack are illustrated in Figs. 19-20 and include an inner frame member 112 that supports a circuit board 113 on one side and a cable wire termination block 114 on the other side of the frame member 112. IDT terminals 115 are supported within the termination block 114 and the IDT terminals 115 includes tail portions 115a that contact the inner circuit board 113 by way of a series of vias 113a. The IDT terminal contact portions extend longitudinally in the terminal block 114 on opposite sides of wire slots formed therein. The other side of the inner circuit board 113 supports an array of terminals 116 that are partially held in place by a two-piece clam-shell support, shown as a terminal comb 117.

[0097] The jack front cover 124 has a central opening that defines a receptacle 118 that is configured to receive a patch panel cable plug therein (not shown) and the jack terminals 116 extend longitudinally within the jack receptacle 118 and the free ends 116a thereof are captured within grooves or other openings formed in a positioning support plate 116b. The jack terminals 116 are captured, but are free to deflect upwardly and downwardly in a vertical direction under pressure created by the insertion of the cable plug into the receptacle 118. The jack 110 further may include an internal switch assembly 120, illustrated as a horizontal plate 120a which supports two terminals 121, 122. The first one 121 of the terminals has a U-shaped configuration that preferably extends in a single plane. The second terminal 122 also has a U-shape but is bent slightly back upon itself so that is extends in two intersecting planes. Both terminals 121, 122 are terminated at their tails to the jack circuit board 113 and both extend longitudinally in the jack receptacle 118. The second terminal 122 is arranged so that it extends within a space bounded by the first terminal 121 and it is slightly angled upwardly with respect to the first terminal 121 so that it is spaced vertically apart from it.

[0098] The front end 122a of the second terminal 122 is bent backwards at an upward angle as illustrated to present a tang that a cable plug engages when it is inserted into the jack receptacle 118. The cable plug makes contact with the angled front end 122a of the second terminal 122 and forces it downward into shorting contact with the first terminal 121. These terminals 121, 122 comprise an internal switch in each jack that can provide a connecting signal to the patch panel electronics, which indicates complete insertion by a cable plug into the jack receptacle 118 as well as indicates a complete connection with the jack terminals 116. If the signal provided by the shorting contact merely indicates that the plug is fully inserted, it informs the installer and/or end user that the patch panel port should be live and producing an operational signal. No signal will indicate that either the cable or the cable plug is bad, while a signal will indicate the cable and its plugs are good. When the assemblies of the Present Disclosure are utilized with shielded modular plugs, the jacks 110 include opposing ground terminals 118a that will establish a ground circuit between the opposing plugs and the jack covers 124 allowing for a through ground connection.

[0099] Importantly, the jacks 110 of the patch panel assemblies 30 of the Present Disclosure are singular jacks, meaning that they are individual jacks that may be selectively inserted into and removed from the housing first openings 55. As such, they can be terminated to individual associated cables by an installer prior to installation of them into the patch panel frame 32. This is an advantage over a structure similar or identical that described in the '707

Patent, where the jack housings are attached to one surface of one circuit board and the termination blocks are attached to the other surface of the one circuit board. Such a structure will not permit the use of a punch down tool when the jack housing and termination block are mounted to a circuit board. With the structure of the jacks 110 of the Present Disclosure, the termination blocks 114 are held in place within the jack front cover 124 by way of stop surfaces 114a that abuttingly engage stop surfaces disposed within the interior of the front jack cover 124. Additionally, the termination blocks 114 may include catches 114b that project outwardly and which are received in corresponding openings 125a of the jack front cover 125. The catches 114b may be depressed inwardly to free them from engagement with the jack front cover 124 so that the interior assembly may be removed.

[00100] The termination blocks 114 are therefore held reliably in place within the jack front covers and they extend rearwardly therefrom. An ordinary IDT wire termination tool may be used and because the jack front covers 125 are preferably made from metal, they can define hard reaction surfaces to bear against a termination jig, or tool, during the termination process. There is no worry about damaging the circuit boards 86 as there would be in a structure in accordance with the '707 Patent. In yet another important aspect of the Present Disclosure, the jacks 110 are provided with exterior terminals, or contacts 138, which are configured to contact the housing terminal first tails 65 when the jacks are inserted into the housings 46. These exterior terminals 138 are terminated at their tail portions 139 to the inner circuit board 113 and are connected to the jack terminals 115, 116 by traces disposed on the circuit board 113. The terminals 138 have contact portions 140 at their free ends and the terminal 138 are shown as having an overall C-shape in order to define a curved front portion 140a of the terminal contact portions 140. The jack connecting terminals curved front portions 140a will contact the housing terminal first tails 65 and they and the free end contact portions 140 will preferably contact the first terminal contact portions 65a.

[00101] This manner of insertion of a jack 110 into a first opening 55 of a patch panel housing 46 effectively provides a connecting path, via the housing interposed terminals 63, between the jack inner terminals 116 and circuits and electronic elements on a circuit board 86. The cables terminated to the jacks 110 are supported by the cable manager 40 and they may be supported by weaving them in and out of the cable manager slots 41 thereof. The cable manager 40, in its offset configuration maintains the cables at a height above the frame base plate 34 no less than NH in order to provide clearance to the panel frame nest 108 to

accommodate the circuit board modules 36 in their movement in and out of engagement with the housing circuit board openings 56.

[00102] With the ports of the patch panel assemblies of the Present Disclosure separated into discrete groups, single groups of ports or all of the ports of the patch panel may now be replaced, repaired and/or upgraded without having to take all of the patch panel ports out of operation. The jacks of any single housing may be replaced individually without disturbing the other jacks in that housing or the remaining jacks in the patch panel assembly. Likewise, the circuit board may be removed and replaced, repaired or upgraded individually by pulling it out or inserting it underneath the cable array and associated jacks, without requiring removal of any of the jacks or housings. A single circuit board may be easily replaced with multiple circuit boards, either standing alone or as incorporated into a module type structure as discussed above. The modular ability of the patch panel assemblies can even permit an end user to utilize some of the ports of a patch panel for high-speed applications, while maintaining the remaining ports of the patch panel for low-speed applications, an aspect that was not feasibly accomplished in patch panels of the '707 Patent style.

[00103] While a preferred embodiment of the Present Disclosure is shown and described, it is envisioned that those skilled in the art may devise various modifications without departing from the spirit and scope of the foregoing Description and the appended Claims.

CLAIMS

WHAT IS CLAIMED IS:

1. A patch panel assembly, the patch panel assembly comprising;

a patch panel frame, the patch panel frame having at least one frame opening disposed therein, each frame opening providing access to a port of the patch panel assembly;

a housing, the housing engaging the frame proximate the frame opening, the housing including a housing body, the body including a plurality of first openings, each first opening being accessible through the frame opening, each first opening defining a network port, the housing body further including at least one second opening, each second opening being associated with and spaced apart from the first openings, the housing body further including a plurality of terminals supported thereon, the terminals being disposed between each second opening and the first openings, the terminals including opposing first and second tails, the tails being respectively associated with the first openings and one second opening;

at least one circuit board, each circuit board being operatively associated with the first openings, each circuit board including at least one mating blade received in one second opening and a plurality of contact pads, the contact pads engaging contact portions of the second tails; and

a plurality of jacks, each jack including an outer housing and an inner cavity, the inner cavity for receiving a plug therein, each jack being respectively received within the first openings, each jack engaging contact portions of the first tails, defining individual ports.

2. The patch panel assembly of Claim 1, wherein the patch panel frame includes a plurality of individual indicator openings, each indicator opening being associated with one port.

3. The patch panel assembly of Claim 2, wherein the housing further includes at least one channel, each channel being associated with one first opening, each channel having a front portion, which extends forwardly under the one first opening, and a rear portion, that extends rearwardly of the one first opening and communicates with one second opening.

4. The patch panel assembly of Claim 3, wherein each circuit board further includes at least one light pipe, the light pipe being received within one channel.

5. The patch panel assembly of Claim 3, further including at least one light-emitting diode ("LED"), the LED being disposed on one circuit board, the LED being aligned with one channel and proximate one light pipe.

6. The patch panel assembly of Claim 1, wherein the first and second tails include spring arms, the spring arms compensating for dimensional variations of the jacks and one circuit board.

7. The patch panel assembly of Claim 6, wherein the first and second tail contact portions include curved portions.

8. The patch panel assembly of Claim 1, wherein each first opening includes locating slots, the locating slots configured to receive locating ribs, the locating ribs being disposed on the jacks.

9. The patch panel assembly of Claim 1, wherein the outer housings are conductive, and the panel frame is formed from a conductive material, each outer housing including at least one grounding clip, each grounding clip connecting one outer housing to the patch panel frame to provide a ground path from that outer housing to the patch panel frame.

10. The patch panel assembly of Claim 1, wherein each jack further includes:

an inner cavity, the inner cavity being configured to receive a plug therein;

a plurality of first terminals for contacting the plug;

a plurality of second terminals for contacting individual wires of a multi-wire cable, the first and second terminals being connected together; and

a plurality of third terminals connected to the first and second terminals.

11. The patch panel assembly of Claim 10, wherein each jack further includes a circuit board, the circuit board operatively interconnecting the first, second and third terminals.

12. The patch panel assembly of Claim 10, wherein the first and second terminals are contained within the outer housings, and the third terminals extend exterior of the outer housings in alignment with the first tails.

13. The patch panel assembly of Claim 12, wherein the third terminals are isolated from conductive contact with the jack housings.

14. The patch panel assembly of Claim 1, wherein the first openings extend vertically in the housing body, and the second opening extends horizontally in the housing body.

15. The patch panel assembly of Claim 1, wherein each jack further includes catches disposed thereon, and the housing further includes latch members, the latch members engage the catches when each jack is fully inserted in the first openings.

16. The patch panel assembly of Claim 15, wherein the latch members extend from the housing along said the openings in a cantilevered fashion and terminate in free ends, the free ends being accessible from the exterior of the patch panel frame in order to release the latch members from engagement with the catches.

17. The patch panel assembly of Claim 1, wherein each circuit board further includes circuitry, the circuitry associated with individual jacks of one set of first openings.

18. The patch panel assembly of Claim 1, wherein each jack further includes an internal switch, the internal switch indicating whether a plug is fully inserted into the inner cavity of that jack.

19. The patch panel assembly of Claim 18, wherein the internal switch includes first and second contacts, and the full insertion of a plug into the inner cavity moves the second contact into shorting contact with the first contact, signaling that the plug is fully inserted into the inner cavity.

20. The patch panel assembly of Claim 19, wherein the second contact exerts a biasing force against a fully-inserted plug.

21. The patch panel assembly of Claim 1, wherein each jack further includes termination blocks, the blocks being disposed within the outer housing, the blocks terminating cable wires thereto with the aid of a punch down tool.

22. The patch panel assembly of Claim 1, wherein removal of each jack does not require the removal of the circuit board and vice-versa.

23. The patch panel assembly of Claim 1, further including a module, the module including a base plate, a cover plate and a rear end cap, the circuit board being held between the base plate and the cover plate, the rear end cap extending for at least a width of the circuit board, thereby providing a handle for the module to facilitate insertion and/or removal of the circuit board from the patch panel assembly.

24. A modular patch panel assembly for a computer network, the assembly comprising:

a panel frame, the panel frame including an associated face plate, the face plate including a plurality of lengthwise slots;

a plurality of housing members, the plurality being no greater in number than a number of face plate slots, each housing member including an array of jack openings, each jack opening receiving a plurality of data jacks therein, each jack opening defining a plurality of individual ports for the computer network, each housing member further including a circuit board opening and an array of conductive terminals, the circuit board opening receiving a mating edge of a circuit board therein, each of the array of conductive terminals being disposed on the housing member and extending between one jack opening and one circuit board opening;

at least two circuit boards, each circuit board including at least one mating blade and contact pads, each mating blade received within one circuit board opening, the contact pads being contacted by tails of the conductive terminals; and

a plurality of data jacks, each jack being received within one jack opening, each jack including an outer shell, a plurality of IDT terminals and a plurality of exterior terminals, the outer shell enclosing a plurality of interior terminals for mating with an opposing plug, each IDT terminal mating with wires of a network cable, each exterior terminal operatively connecting the interior and IDT terminals to the conductive terminals.

25. The patch panel assembly of Claim 24, wherein each jack opening includes a latch member, the latch member retaining a single jack therein, each jack further includes at least one catch, each catch disposed on the outer shell of the jack, each catch being engaged by the latch member when said jack is fully inserted into said jack opening.

26. The patch panel assembly of Claim 25, wherein the face plate further includes a plurality of longitudinal slots, the latch members extending into the slots, whereby a tool may be inserted into the slots to release the latch members from engagement therewith.

27. The patch panel assembly of Claim 24, wherein the outer shells are conductive and the exterior terminals are isolated from contact therewith.

28. The patch panel assembly of Claim 24, further including indicator switch assemblies disposed within each jack, the switch assemblies transmitting operational status signals under pressure of the plug, the plug being fully inserted into the jack.

29. The patch panel assembly of Claim 28, wherein portions of the switch assemblies urge the fully-inserted plugs into jack cavities, the jack cavities being disposed against the interior terminals.

30. The patch panel assembly of Claim 24, wherein the conductive terminals include spring ends, the spring ends accommodating dimensional and/or alignment variations in the jacks and the circuit boards.

31. The patch panel assembly of Claim 24, wherein the circuit boards may be removed and replaced from the housing members without terminating new cables to the jacks.

32. A modular patch panel assembly, the modular patch panel assembly comprising:

a frame;

a plurality of housings, the housing being mountable to the frame, each housing including N jack openings formed therein, associated circuit board openings and

conductive terminals supported thereon, one circuit board opening being disposed in each housing and associated with one jack opening, individual housings may be installed in and removed from the frame without disturbing other housings;

a plurality of jacks, each jack being individually received in one jack openings; and

at least one circuit board, each circuit board being received in one circuit board openings;

wherein the conductive terminals contact circuitry on each circuit board and circuitry on each jacks.

33. The modular patch panel assembly of Claim 32, wherein selected jacks may be installed in or removed from the jack openings without removing or disturbing other jacks.

34. The modular patch panel assembly of Claim 32, wherein said circuit board may be installed in or removed from said frame individually without disturbing any of said jacks of said patch panel assembly

35. The modular patch panel assembly of Claim 32, wherein each jack includes terminals that extend outside thereof, and contact opposite ends of a tail of the housing terminal.

36. The modular patch panel assembly of Claim 32, further including light pipes, the light pipes extending through the housings from a location proximate the LEDs, disposed on the circuit boards, to a distal front face of the frame.

37. The modular patch panel assembly of Claim 32, wherein the housings include latch members, each latch member releasably retaining one jack within one jack opening, the latch members being manipulatable from either a forward or a rearward direction.

38. The modular patch panel assembly of Claim 32, wherein N is a number selected from the group consisting essentially of 1, 2, 3, 4, 6, 8, 12 and 24.

39. The modular patch panel assembly of Claim 32, further including a plurality of light pipes, each light pipe being supported by one housing, at least one light pipe being

associated with each jack opening, the light pipes being disposed adjacent light-emitting ends of LEDs disposed on the circuit boards.

40. A network patch panel, the network patch panel comprising:

a frame, the frame supporting a face plate, the face plate including a plurality of widthwise openings defined therein;

a plurality of housings, each housing being disposed within one face plate opening, each housing including a body portion and at least one circuit board opening, each body portion having a plurality of walls that cooperatively divide each face plate openings into a plurality of jack openings; and

a plurality of single jacks, each jack being received within one jack opening, each jack including catches disposed on exterior surfaces thereof;

wherein each housing includes latch members formed thereon and extending into each jack opening into engagement with the catches, the latch members being releaseable by accessing them with a tool from either front or rear directions.

41. A modular patch panel assembly, the modular patch panel comprising:

a frame;

a plurality of housings, the housings being mountable to the frame, each housing including N individual jack openings formed therein and one circuit board opening being disposed in each housing and associated with one jack opening;

a plurality of jacks, each jack being terminable and received in one jack opening of each housing; and

at least one circuit board, each circuit board being received in one circuit board opening;

wherein each housing further includes conductive terminals, the conductive terminals being supported thereon, and which contact between circuitry on the circuit board and circuitry of the jacks, whereby individual jacks may be installed in and removed from the housings without disturbing other jacks of the patch panel assembly, and an individual circuit board may be installed and removed from the patch panel assembly without disturbing the jacks.

42. A housing for a network patch panel, the housing comprising:

a body portion, the body portion including at least one first opening configured to receive a data jack therein, and at least one second opening configured to receive a mating blade of a circuit board, the first and second openings being aligned with each other and separated from each other by an intervening space; and

a plurality of conductive terminals, each conductive terminal being supported by the body portion and extending between the first and second openings;

whereby, when a jack is inserted into the first opening, electrical contact is made between the jack and the conductive terminals and, when a circuit board is inserted into the second opening, electrical contact is made between the circuit board and the conductive terminals, thereby connecting the jack and circuit board together.

43. The patch panel housing of Claim 42, wherein the first opening extends vertically in the body portion, and the second opening extends horizontally in the body portion.

44. The patch panel housing of Claim 42, wherein the first and second openings extend in different, intersecting directions.

45. The patch panel housing of Claim 42, wherein the first opening defines a hollow passage that extends completely through the body portion.

46. The patch panel housing of Claim 42, wherein the terminals include retention portions which engage the body portion, and first and second tail portions extend in a cantilevered fashion from the retention portions, the first and second tail portions being respectively aligned with the first and second openings.

47. The patch panel housing of Claim 46, wherein the retention portions extend vertically and the first and second tails extend at angles therefrom.

48. The patch panel housing of Claim 46, wherein the second tails extend axially into the second opening.

49. The patch panel housing of Claim 42, wherein the first opening is defined at least in part by a plurality of sidewalls, at least one sidewall includes a shoulder portion configured to engage a stop surface of a jack inserted therein.

50. The patch panel housing of Claim 42, wherein the body portion includes a plurality of housing first openings.

51. The patch panel housing of Claim 42, wherein the housing includes a latch for fixing a jack in the first opening.

52. The patch panel housing of Claim 51, wherein the latch can be manipulated from opposite sides of the patch panel in order to disengage it from the jack and permit the jack to be removed from the first opening.

53. The patch panel housing of Claim 42, wherein the body portion includes a base and a plurality of terminal-receiving slots disposed in the base, and the slots are aligned with the terminals to receive portions thereof when a jack is fully inserted into one first opening.

54. The patch panel housing of Claim 42, further including at least one channel disposed in the body portion, each channel extending axially therethrough, the channel communicating with the second opening and communicating with an alcove disposed beneath one first opening.

55. The patch panel housing of Claim 54, further including a light pipe disposed in the channel.

56. A housing for use in a network patch panel, the housing comprising:

a body portion, the body portion defining at least one set of individual ports for the patch panel, the body portion including an array of jack openings, corresponding in number to one set of individual ports, each jack opening being configured to receive a data jack therein;

a circuit board opening, the circuit board opening disposed in the housing and configured to receive at least one mating edge of an associated circuit board, the circuit board

opening being aligned with one set of ports and the jack openings, the circuit board opening being spaced apart therefrom by an intervening space; and

a plurality of conductive terminals supported by the body portion so as to extend in a direction between the first and second openings to electrically connect jacks inserted into the jack openings and circuits on a circuit board inserted into the circuit board opening.

57. The housing of Claim 56, wherein the terminals include retention portions engaging the body portion and first and second tail portions extending from opposite ends of the retention portions, the first tail portions being aligned with axes of jack openings and the second tail portions extending into the circuit board openings, whereby the first tail portion's contact jacks inserted into the jack openings and the second tail portions contact circuits on a circuit board inserted into the circuit board openings connect the jack with the circuit board.

58. The housing of Claim 57, wherein the first and second tail portions are cantilevered from retention portions.

59. The housing of Claim 56, wherein the body portion includes a base and a plurality of spaced apart sidewalls which cooperate to define the jack openings.

60. The housing of Claim 59, further including top walls interconnecting the sidewalls, the top walls including latch members respectively associated with the jack openings, the latch members extending into the jack openings to engage jacks inserted therein.

61. The housing of Claim 60, wherein the latch members include stop surfaces, the stop surfaces engage confronting catches disposed on top surfaces of jacks inserted into the jack openings.

62. The housing of Claim 61, wherein the latch members include members associated therewith for releasing the latch members from engagement jacks, and from the exterior of the patch panel.

63. The housing of Claim 56, wherein the jack openings extend in one direction, and the circuit board openings extend in a different direction.

64. The housing of Claim 56, where the housing includes a plurality of stop surfaces that limit the extent to which jacks may be inserted into the jack openings.

65. A connector for connecting a plurality of jacks with at least one circuit board, the connector comprising:

an insulative connector body, the connector body supporting a plurality of jack housings, each housing configured to receive a jack therein, the housings including latches for releasably latching jacks in place in the housings, the connector body further including circuit board openings, each circuit board opening being associated with a preselected number of jack housings; and

a plurality of conductive terminals supported by the connector body, each conductive terminal extending between the jack housings and the circuit board openings to provide conductive paths between circuitry of the jack housings and circuitry of the circuit board housings.

66. The connector according to Claim 65, wherein the terminals include retention portions and first and second tail portions, the retention portion engaging the connector body, the first tail portions extending from the terminal retention portions toward the jack housings, the second tail portions extending from the terminal retention portions into the circuit board housings.

67. The connector according to Claim 66, wherein the first and second tail portions include curved contact portions.

68. The connector according to Claim 65, wherein the connector body includes a plurality of channels, each channel being associated with one jack housing, the channels beings disposed beneath the jack housings, each channel communicating, at a first end thereof, with the circuit board openings and, at a second end thereof, with an area beneath the jack housings.

69. The connector according to Claim 68, further including a plurality of light pipes, each light pipe having first sections, received within first ends of the channels, and second sections, received within second ends of the channels.

70. The connector according to Claim 69, wherein the light pipe first and second sections have different cross-sectional configurations.

71. The connector according to Claim 65, wherein the connector body is configured to fit into an opening slot in a patch panel.

72. The connector according to Claim 65, wherein the jack housings extend vertically, and the circuit board housings extend horizontally.

73. A jack insertable into and removable from a patch panel, the jack comprising:

a housing defining a receptacle, the housing including an entrance opening, the entrance opening permitting passage of an opposing plug into the receptacle, the housing further including an exit opening, the exit opening receiving a termination end of a multi-wire cable therein, a plurality of interior terminals supported in an inner cavity of the housing;

a body portion, the body portion being disposed in the housing, a plurality of insulation displacement terminals supported by a termination block portion of the body portion, each insulation displacement terminal being operatively connected to one interior terminal; and

a plurality of exterior terminals operatively connected to the interior terminals and the insulation displacement terminals, each exterior terminals having contact portions that extend out from the housing for contacting opposing terminals of a patch panel port into which the jack is configured to fit.

74. The jack of Claim 73, further including a circuit board disposed within the housing, the inner terminals, the insulation displacement terminals and the exterior terminals being connected together by the circuit board.

75. The jack of Claim 73, wherein the housing is formed from a conductive material, and the exterior terminal contact portions are isolated from electrical contact with the housing.

76. The jack of Claim 73, wherein the exterior terminals include contact portions and tail portions disposed at opposite ends thereof, the exterior terminals having configurations such that the contact and tail portions face the same direction.

77. The jack of Claim 73, wherein the exterior terminals have first and second free ends, the first free ends being connected to the circuit board, and the exterior terminals including curved portions interposed between the first and second free ends.

78. The jack of Claim 73, wherein the housing includes at least one catch for engaging a patch panel port.

79. The jack of Claim 78, wherein the housing further includes a pair of shoulders on opposite sides thereof, the shoulders engaging a patch panel port, the shoulders being aligned with the one catch.

80. The jack of Claim 73, wherein the housing includes interengaging front and rear covers and at least one grounding terminal, each grounding terminal supported by one of the front and rear covers for establishing a ground connection with an opposing plug.

81. The jack of Claim 73, wherein the housing further includes at least one locating rib extending longitudinally on an exterior surface thereof.

82. The jack of Claim 73, further including an internal switch disposed within the jack receptacle, the switch being in an open position within an empty jack receptacle, and in a closed position in response to pressure exerted on it by insertion of a plug fully into the receptacle.

83. The jack of Claim 82, wherein the switch includes an inner and outer terminal, the inner terminal having a plug contact portion which contacts a plug fully inserted into the jack receptacle, the outer terminal having a shorting portion disposed beneath the plug contact portion, whereby insertion of a plug fully into the jack receptacle forces the inner terminal into shorting contact with the outer terminal.

84. The jack of Claim 73, wherein the plug contact portion exerts a retention pressure on a plug inserted fully in to the jack receptacle.

85. The jack of Claim 73, wherein the exterior terminals extend along an exposed edge of the circuit board, and an exposed edge of the circuit board extends out of the housing in a manner such that the exterior terminals are isolated from shorting contact with the housing.

86. The jack of Claim 73, wherein the jack terminals extend longitudinally within the receptacle, and the inner and outer terminals extend longitudinally with the receptacle, the jack terminals and the inner and outer terminals being spaced apart from each other.

87. A jack for insertion into a patch panel assembly and connecting to circuits on a circuit board, the jack comprising:

a jack housing, the jack housing including a hollow interior and a cable opening, the hollow interior defining, at least in part, a cavity configured to receive a data plug therein, the cable opening receiving a multi-wire cable therein;

a inner body portion disposed within the hollow interior, the inner body portion including a termination block disposed within the jack housing, the termination block including a plurality of insulation displacement terminals (IDTs) for contacting wires of the cable, the IDTs extending in a first plane within the hollow interior, the inner body portion further supporting a plurality of plug-contacting terminals extending in a second plane within the hollow interior; and

a plurality of panel-contacting terminals operatively connected to the plug-contacting terminals and the IDTs, the panel-contacting terminals including portions extending out of the jack housing for contacting opposing terminals of a patch panel assembly.

88. The jack of Claim 87, wherein said inner body portion further includes a circuit board which operatively connects said plug-contacting terminals, IDTs and patch panel-contacting terminals together.

89. The jack of Claim 88, wherein said circuit board extends in a third plane angularly offset from the first and second planes.

90. The jack of Claim 88, wherein said circuit board includes an exposed edge which extends out of said jack housing, and said panel-contacting terminals have free ends that define contact portions which extend along the circuit board exposed edge.

91. The jack of Claim 90, further including, wherein said jack housing is conductive and said patch panel-contacting terminals are isolated from contact with said jack housing.

92. The jack of Claim 87, further including at least one catch disposed on said jack housing for engaging said patch panel assembly.

93. The jack of Claim 92, further including stop surfaces disposed on said housing for engaging said patch panel assembly.

94. The jack of Claim 87, further including at least one locating rib disposed on said housing.

95. The jack of Claim 87, further including an internal switch assembly disposed in the cavity, the switch assembly being operable between a first position that indicates said cavity is empty and a second position which indicates a data plug is fully inserted into said cavity.

96. The jack of Claim 95, wherein said switch assembly includes a first contact extending longitudinally within said cavity and a second contact extending longitudinally within said cavity, but spaced apart from the first contact, the second contact including distinct first and second portions, the first portion extending at an angle to the second portion such that when a data plug is fully inserted into said cavity, said first portion forces said second contact into shorting contact with said first contact.

97. The jack of Claim 96, wherein said second contact first portion exerts a pressure on a data plug fully inserted therein toward said plug-contacting terminals.

98. The jack of Claim 96, wherein said terminal first and second tails included free spring ends that can deflect under mating pressure from respective jacks and circuit boards and which accommodate dimensional variations of the jacks and circuit boards during mating therewith.

99. A jack, comprising:

a jack housing defining a hollow interior, the jack housing having a cavity for receiving a plug therein, a body portion disposed in the hollow interior and supporting a plurality of first terminals aligned with an extending into the cavity;

a termination block supporting a plurality of second terminals, the second terminals being IDT terminals for mating with wires of a multi-wire cable; and,

a status switch assembly disposed in said hollow interior and extending into said cavity, the status switch assembly including a fixed switch terminal and a moveable switch terminal, the moveable switch terminal contacting the fixed switch terminal in response to a plug being fully inserted into said cavity and thereby shorting said fixed switch terminal to indicate full insertion of said plug in said cavity.

100. The jack according to Claim 99, wherein said fixed switch terminal includes a first U-shaped terminal extending in a first plane and said moveable switch terminal includes a second U-shaped terminal partially bent upon itself so that it extends in second and third planes, the moveable switch terminal including a biasing portion that engages a plug fully inserted into said cavity and forces said moveable switch terminal into shorting contact with said fixed terminal to generate a signal indicating full insertion of said plug into said cavity.

101. The jack according to Claim 100, wherein said biasing portion biases a plug fully inserted in said cavity toward said first terminals.

102. The jack according to Claim 99, further including third terminals operatively interconnected to said first terminals and isolated from shorting contact with said housing, the third terminals extending out of said jack housing.

103. A jack for use in a patch panel assembly, comprising:

a conductive jack housing for making ground contact with a portion of the patch panel assembly, the jack housing including a inner cavity for receiving a

corresponding, opposing plug connector, said jack housing having an entrance opening leading to the inner cavity;

first terminals arranged within said inner cavity for contacting terminals of the opposing plug connector;

second terminals for engaging wires of a cable, the second terminals being connected to the first terminals and the second terminals being supported by a termination block disposed with said jack housing; and,

said jacks being capable of being terminated to cable wires by use of a termination tool.

104. A housing with integrated indicators for use with a patch panel having a frame with an opening through which network ports are accessed, comprising:

a housing body for attachment to a patch panel frame, the housing body defining a plurality of jack openings for receiving a plurality of jacks therein, and said housing body including at least one circuit board opening for receiving a circuit board therein, the circuit board supporting at least one LED on a surface thereof; and,

at least one light pipe supported by said housing body portion, the one light pipe including an input end, an output end and a body portion interconnecting the two ends together, said housing supporting said light pipe input end in abutting engagement with the one LED on said circuit board.

105. The housing of Claim 104, wherein said light pipe input and output ends are supported at different elevations within said housing.

106. The housing of Claim 104, wherein said light pipe is disposed in a channel that communicates with the circuit board opening.

107. The housing of Claim 106, wherein said light pipe input end is maintained in said channel when a circuit board is inserted into said circuit board opening.

108. The housing of Claim 104, further including at least one passage disposed in said housing which receives a portion of said one light pipe therein.

109. The housing of Claim 108, wherein said passage communicates with said one circuit board opening and said passage directs said light pipe input end into abutting engagement with said circuit board LED

110. The housing of Claim 109, wherein said passage aligns said light pipe output end with one of said jack openings.

111. The housing of Claim 109, wherein said passage communicates with a space underneath one of said jack openings.

112. The housing of Claim 104, wherein said light pipe had an offset configuration.

113. The housing of Claim 104, wherein said housing includes a hollow alcove beneath each of said jack openings and further includes a plurality of light pipes, the light pipes extending between the alcoves and said circuit board opening.

114. A patch panel assembly, comprising:

a patch panel frame;

a housing body attached to the patch panel frame, the housing body defining a plurality of jack openings for receiving a plurality of jacks therein, said housing body including at least one circuit board opening for receiving a circuit board therein;

a circuit board including a mating blade received in the circuit board, the circuit board including a plurality of LEDs supported on a surface thereof, the LEDs extending perpendicular to a plane of said circuit board; and,

at least one light pipe associated with each one of the jack openings, the light pipes each including an input end, an output end and a body portion interconnecting the two ends together, the light pipe input ends extending into said circuit board openings such that they abut said LEDs and said circuit board at least partially retains said light pipe input ends in place within said circuit board openings.

115. The patch panel assembly of Claim 114, wherein the light pipe input and output ends are supported at different heights on said patch panel assembly.

116. The patch panel assembly of Claim 115, wherein said light pipe output ends are disposed on said patch panel assembly at a level above said light pipe input ends.

117. The patch panel assembly of Claim 114, wherein said housing body portion includes an axial passage therethrough which communicates at one end thereof with said circuit board opening and which communicates with an area beneath said jack opening at the other end thereof.

118. The patch panel assembly of Claim 117, wherein mating edges of said circuit board contact said light pipe first portions within said circuit board opening to at least partially retain them in place within said passages.

119. The patch panel assembly of Claim 114, wherein said light pipe has a first portion that has a square or rectangular configuration and a second portion that has a cylindrical configuration.

120. The patch panel assembly of Claim 119, wherein said circuit board opening includes a plurality of slots which communicate therewith, the slots containing portions of said light pipes.

121. A modular, patch panel frame, comprising:

a frame, the frame including a faceplate and a base plate extending rearwardly from said faceplate and at least one wall extending lengthwise therealong to define a side edge of said frame, the faceplate including at least one opening disposed therein;

a housing mountable to the frame and configured to communicate with the opening, the housing including a plurality of individual jack openings extending vertically in said housing and configured to receive therein individual jacks terminated to individual cables, said housing further including a circuit board opening extending horizontally in said housing configured to receive a mating blade of a circuit board therein, and, said housing including a plurality of conductive terminals extending into the circuit board opening; and,

a circuit board module supporting a circuit board, the circuit board including a mating blade with a plurality of contact pads disposed proximate thereto, the module further including an enclosure that houses a portion of said circuit board such that said circuit board mating blade extends out of the enclosure, said circuit board being supported in said

enclosure so that its mating blade opposes said housing circuit board opening and said enclosure being slidable upon said panel frame base plate such that said circuit board mating blade is matable with said circuit board opening and housing terminals by pushing said module toward said housing.

122. The patch panel frame of Claim 121, wherein said frame includes a nest which accommodates said enclosure.

123. The patch panel frame of Claim 122, wherein jack openings are disposed in said housing at a level above said circuit board such that the nest occupies an area beneath said jack openings.

124. The patch panel frame of Claim 122, wherein said enclosure may be pushed into and pulled out of the nest by a user without contacting any jacks in said jack openings.

125. The patch panel frame of Claim 122, further including a cable manager spaced rearwardly from and aligned with said jack openings, the cable manager being disposed above said nest and configured to support cables of jacks inserted into said jack openings without interfering with movement of said module into or out of said nest.

126. The patch panel of Claim 121, wherein said module includes at least one grounding spring disposed on its exterior which contacts said panel frame when said module is disposed in said nest.

127. The patch panel frame of Claim 121, wherein said baseplate includes at least one opening and said module includes at least one engagement member aligned with the baseplate opening, the module engagement member engaging the base plate opening when said enclosure is fully inserted into said nest and said circuit board mating blade is received within said circuit board opening.

128. The patch panel frame of Claim 121, wherein said module further includes a plurality of standoffs that support said circuit board within said enclosure.

129. The patch panel frame of Claim 121, wherein said circuit board mating blade includes a locating slot and said housing circuit board opening includes a dividing post configured to engage said circuit board locating slot.

130. The patch panel frame of Claim 121, wherein said enclosure includes top and bottom covers, each of the two covers include a leading edge, the circuit board mating blade extending out of said enclosure past the two cover leading edges.

131. The patch panel frame of Claim 130, wherein said bottom cover includes a stop surface that limits forward movement of said enclosure within said frame.

132. The patch panel frame of Claim 121, wherein said circuit board supports a plurality of electronic components on a surface thereof and said module includes a non-conductive film sheet covering the electronic components to shield the components from contacting any conductive elements of said frame, said housing or jacks inserted into said jack openings..

133. The patch panel of Claim 121, wherein said module includes a handle for pushing and pulling said module into and out of engagement with said frame.

134. A patch panel assembly, comprising:

a panel frame including a front plate and a baseplate partially defining a receptacle;

a plurality of housings engaging the front plate, the housings each defining a group of jack openings which are configured to receive individual jacks therein, the jack openings being aligned with each other along a first axis parallel to the baseplate, each of said housings further including a circuit board opening associated with each set of jack openings which is configured to receive a leading edge of a circuit board therein, the circuit board openings being aligned with each other along a second axis parallel to said baseplate, the first axis being spaced apart from the base plate by a distance H to define a nest area of said panel frame; and,

a plurality of modules which are engagable with the panel frame, each module including an enclosure with an open end, each enclosure supporting a circuit board therein such that a leading edge of the circuit board projects out of the enclosure open end, and each

said enclosure having a height no greater than H, said modules being independently slidable upon said panel frame base plate in and out of the nest areas.

135. The patch panel assembly of Claim 134, wherein the circuit board leading edge of each module is aligned with a corresponding associated housing circuit board opening.

136. The patch panel assembly of Claim 134, wherein said panel frame includes a plurality of openings and each module includes at least one engagement member configured to engage one of the panel frame openings to hold said module in place within said panel frame.

137. The patch panel assembly of Claim 136, wherein said openings are disposed in said panel base plate and said engagement members are disposed along bottoms of said enclosures.

138. The patch panel assembly of Claim 134, wherein each of said modules includes a grounding spring such that when said modules are fully inserted into said panel frame nest area, all of said modules make grounding contact with each other and said panel frame.

139. The patch panel assembly of Claim 134, further including a cable manager configured to support cables terminated to jacks inserted in said jack openings, the cable manager being spaced no less than H above said panel frame base plate.

140. The patch panel assembly of Claim 134, wherein the first and second axes are horizontal axes.

141. The patch panel assembly of Claim 134, further including a plurality of jacks inserted in said openings, said jacks being spaced no less that H above said panel frame base plate.

142. The patch panel assembly of Claim 134, wherein said circuit boards include first and second surfaces, a plurality of electronic components disposed on the circuit board

first surfaces and LEDs disposed on the circuit board second surfaces between said circuit board mating, the LEDs being disposed on said circuit board second surfaces for mating with input ends of light pipes supported by said housings.

143. The patch panel assembly of Claim 142, wherein said circuit boards support a plurality of electronic components upon at least one surface thereof proximate to said leading edges thereof and said modules include protective films extending over the components to prevent inadvertent shorting contact therewith during module insertion into and removal from said panel frames.

144. A patch panel frame, comprising:

a base, a front and at least one housing defining a jack opening through the front for supporting a jack therein at a specific height NH above the base, the housing further including a circuit board opening disposed therein at a specific height less than NH above said base; and

a module containing a circuit board with a leading edge for mating with the housing circuit board opening, the module having a height less than NH so as to permit the module to be inserted into and removed from mating with said housing circuit board opening without interfering with a jack supported by said housing.

145. The patch panel frame of Claim 144, wherein said module includes a hollow enclosure with an opening and said circuit board leading edge projects out of the opening.

146. The patch panel frame of Claim 144, wherein said module includes a grounding spring for contacting said base.

147. A circuit board module for a patch panel assembly, the patch panel assembly having a frame with a housing, the housing including a plurality of jack openings and circuit board openings, the circuit board openings being disposed beneath the jack openings, and said frame further including a cross member for supporting cables associated with jacks insertable in said jack openings, the circuit board module comprising:

a circuit board having opposing leading and trailing edges which are interconnected by opposing side edges, a plurality of conductive contact pads arranged

proximate to the leading edge, the circuit board including a plurality of electronic components disposed on one surface thereof;

a bottom cover and a top cover which interengage each other to define a hollow enclosure, at least one circuit board support disposed within the enclosure for supporting said circuit board therein;

an end cap extending widthwise between the circuit board opposing edges, the end cap sealing off a rear end of said enclosure; and,

said circuit board leading edge extends out of said enclosure and said module further includes engagement members for engaging said patch panel frame.

148. The circuit board module of Claim 147, wherein said circuit board and enclosure are rectangular in configuration.

149. The circuit board module of Claim 147, further including a film sheet extending over the electronic components so as to protect them from contacting either conductive elements of the patch panel housing or jacks inserted into said jack openings.

150. The circuit board module of Claim 149, wherein the film sheet is an insulative film and said film sheet contacts the top cover of said circuit board module.

151. The circuit board module of Claim 147, wherein said circuit board leading edge includes a polarizing slot.

152. The circuit board module of Claim 147, wherein the module engagement members include hook ends which are configured to engage corresponding opposing engagement openings in said patch panel frame.

153. The circuit board module of Claim 147, wherein said circuit board includes at least one connector mounted on a surface thereof and one of said top and bottom covers includes an opening aligned with the one connector to define a passage communicating with said one connector.

154. The circuit board module of Claim 147, wherein said circuit board support includes a standoff extending between said circuit board and one of said top and bottom covers.

155. The circuit board module of Claim 154, wherein the other of said top and bottom covers includes a recess which contacts said circuit board and spaces it away therefrom.

156. The circuit board module of Claim 147, wherein said circuit board module includes at least one ground spring disposed on a surface thereof so as to contact said patch panel frame when said circuit board module is inserted into said patch panel frame.

157. The circuit board module of Claim 156, wherein said circuit board module includes two ground springs disposed on opposite sides and includes a handle portion that extends between the circuit board module opposite sides.

158. The circuit board module of Claim 147, wherein said top and bottom covers each include a leading edge, the circuit board leading edge extending out of said enclosure past said top and bottom cover leading edges.

159. The circuit board module of Claim 147, wherein said circuit board includes at least one LED supported on a surface thereof and spaced away from said circuit board leading edge for mating with an input end of a light pipe.

160. The circuit board module of Claim 147, wherein said circuit board includes two connectors connected thereto and the two connectors extend in two different, angularly offset directions in alignment with two openings in said top and bottom covers.

161. A module, comprising:

a circuit board, the circuit board including a leading edge and a trailing edge disposed at respective opposite front and rear ends thereof, said circuit board including a plurality of contact pads proximate the leading edge thereof; and,

an enclosure defined by a base plate and a cover plate, each of the base and cover plates including a leading edge, said circuit board being disposed within the enclosure

between the base and cover plates by a plurality of supports, said cover plate having a length less than a corresponding length of said base plate so as to permit said circuit board leading edge to extend out of said enclosure past the leading edges of said base and cover plates, said bottom plate including a stop surface disposed rearwardly of said circuit board leading edge.

162. The module of Claim 161, wherein said circuit board supports a plurality of electronic components, at least some of which are disposed on said circuit board between said circuit board leading edge and a leading edge of said cover plate.

163. The module of Claim 162, further including a film cover extending from said cover plate leading edge and covering at least some of said electronic components.

164. The module of Claim 161, wherein said enclosure includes a rear end wall extending proximate to said circuit board trailing edge, the rear end wall defining a handle for said module.

165. The module of Claim 164, wherein said rear end wall includes at least one engagement hook for engaging a corresponding engagement opening in a patch panel frame.

166. The module of Claim 164, wherein said end wall includes a hook for engaging a frame of an opposing carrier.

167. The module of Claim 161, further including at least one ground spring disposed along a mating edge of said module for providing electrical contact between said enclosure and a nest in a patch panel frame.

168. The module of Claim 161, wherein said one of said top and bottom covers includes an opening aligned with a connector on said circuit board so as to permit access to said connector through said enclosure, the connector extending perpendicularly from said circuit board.

169. A pluggable circuit board enclosure, comprising:

a conductive base member having opposing leading and trailing edges, the base member leading edge being bent out of plane of the base member to define a stop surface of the enclosure;

a conductive cover member having opposing leading and trailing edges, the cover member being combined with said base member to form a hollow enclosure with an opening defined between the base and cover member leading edges; and,

a circuit board having a body portion with opposing leading and trailing edges, a plurality of electronic components disposed on the circuit board body portion, the circuit board being supported within the enclosure such that the circuit board trailing edge is entirely enclosed within said enclosure and the circuit board leading edge extends out of said enclosure and project past said base and cover member leading edges to define a mating blade of said enclosure so that said enclosure may be plugged into a patch panel housing.

170. The pluggable circuit board enclosure of Claim 169, wherein said circuit board includes a plurality of contact pads arranged along said leading edge thereof.

171. The pluggable circuit board enclosure of Claim 169, further including an end cap which engages both of said base and cover members, the end cap including at least one engagement hook disposed thereon for locking said enclosure in place within a patch panel assembly.

172. The pluggable circuit board enclosure of Clam 169, wherein said circuit board is disposed between said base and cover members, and said cover member leading edge is spaced apart rearwardly of said circuit board leading edge.

173. The pluggable circuit board enclosure of Claim 169, wherein said cover member includes a film sheet extending from said cover member leading edge forwardly and over the electronic components to insulate them from contact with a patch panel frame.

174. The pluggable circuit board enclosure of Claim 169, wherein said enclosure includes at least one grounding spring for contacting a patch panel frame or an adjacent enclosure.

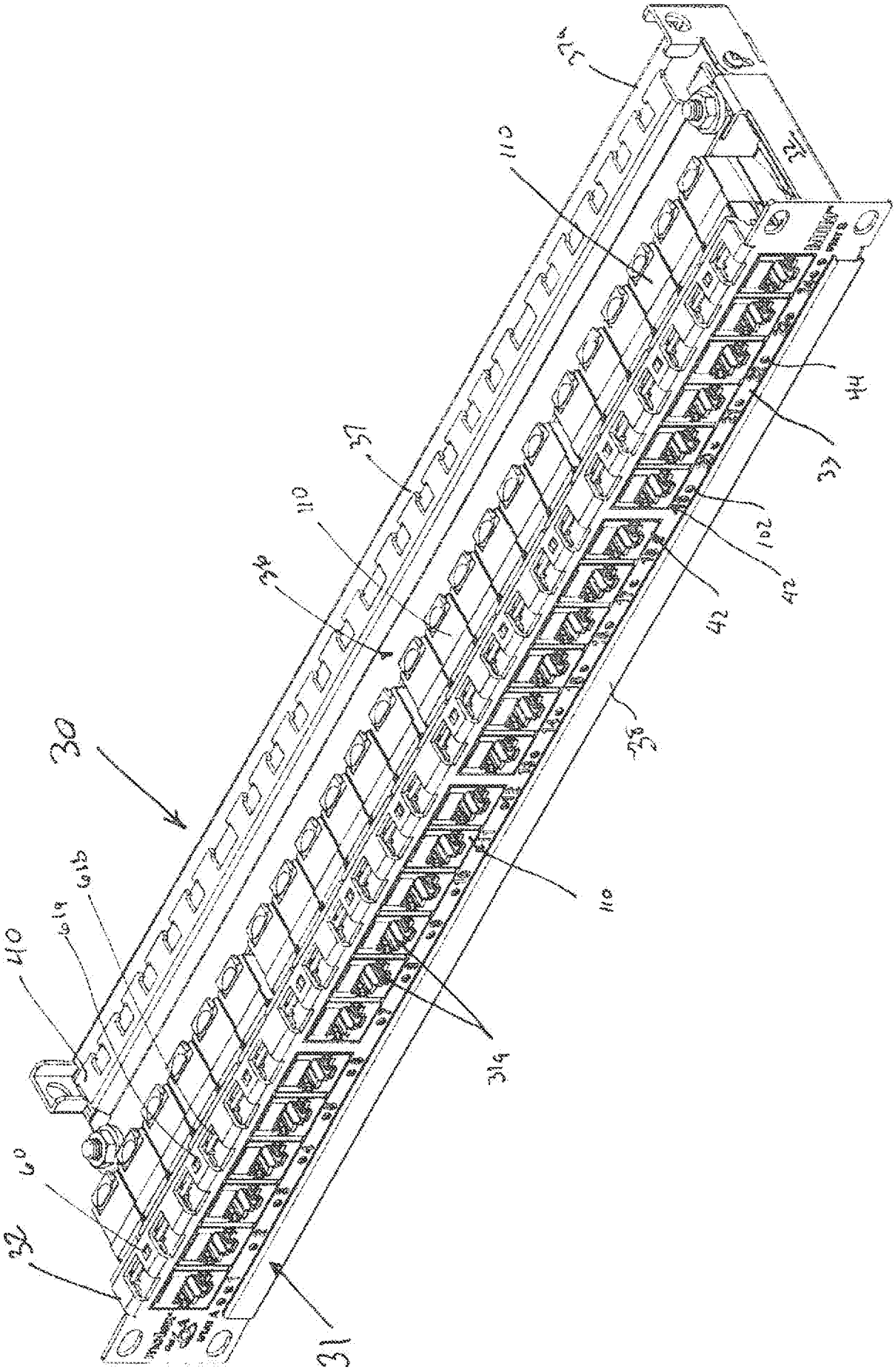
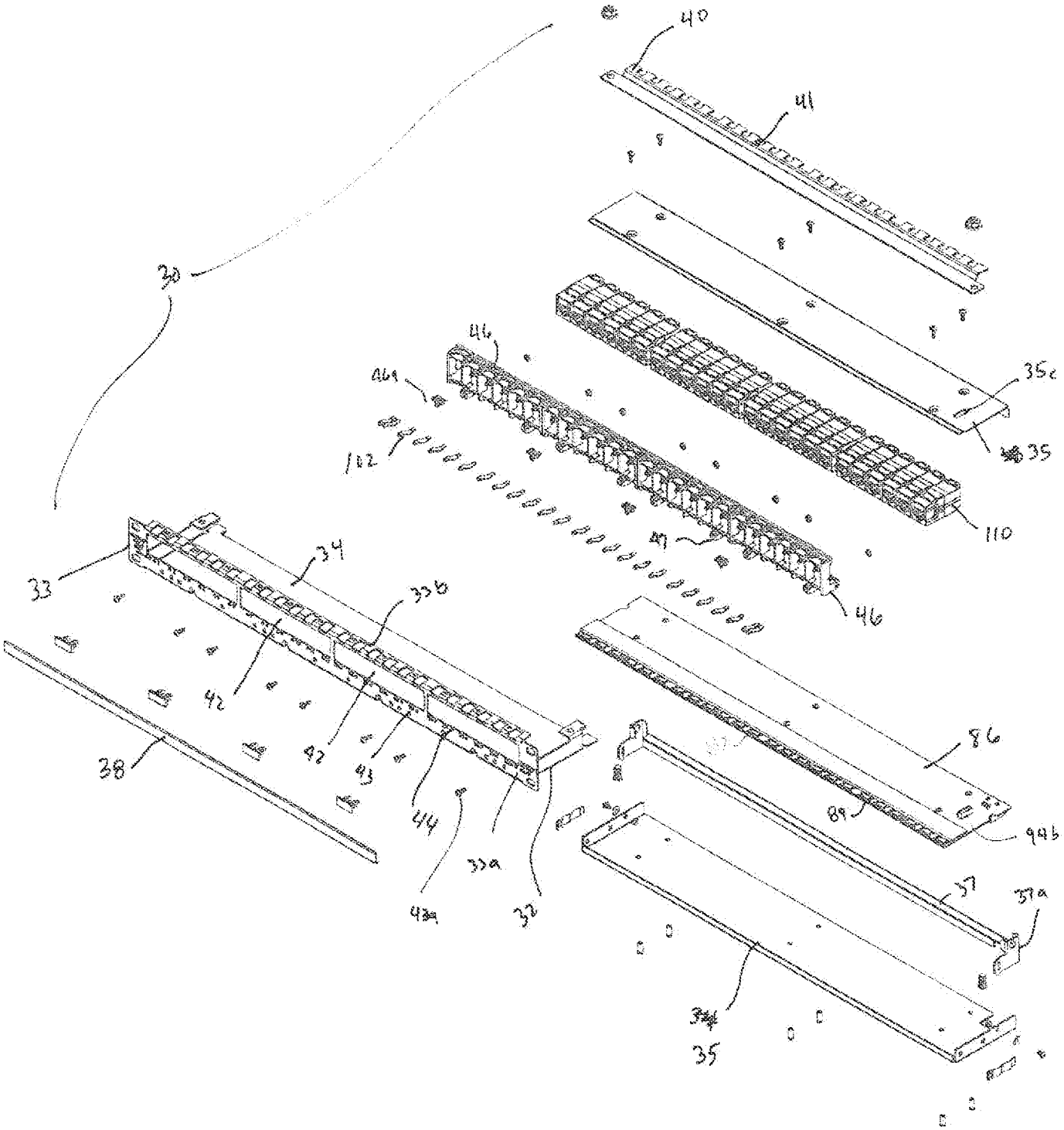


Fig. 1

Fig. 2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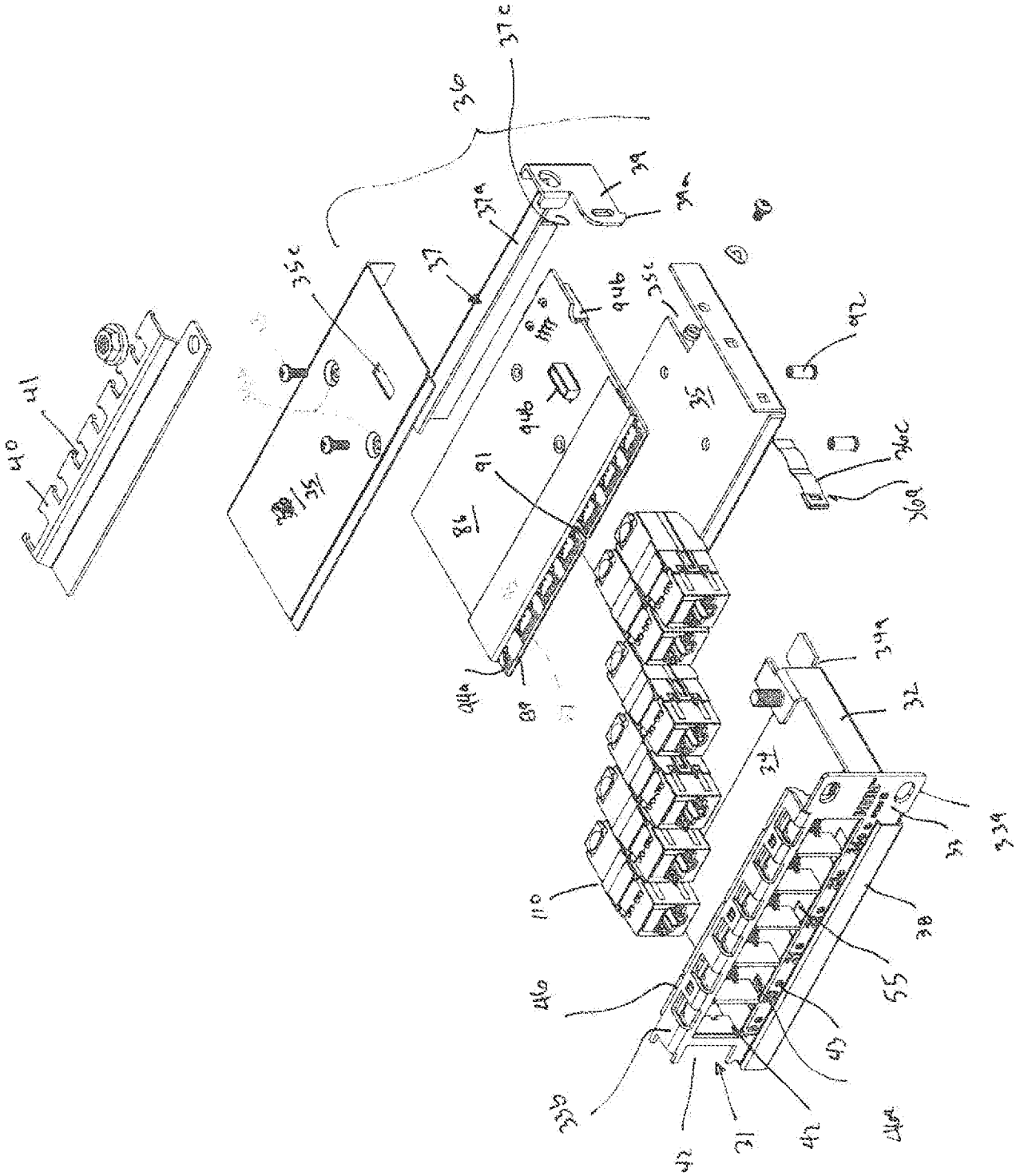


Fig. 3

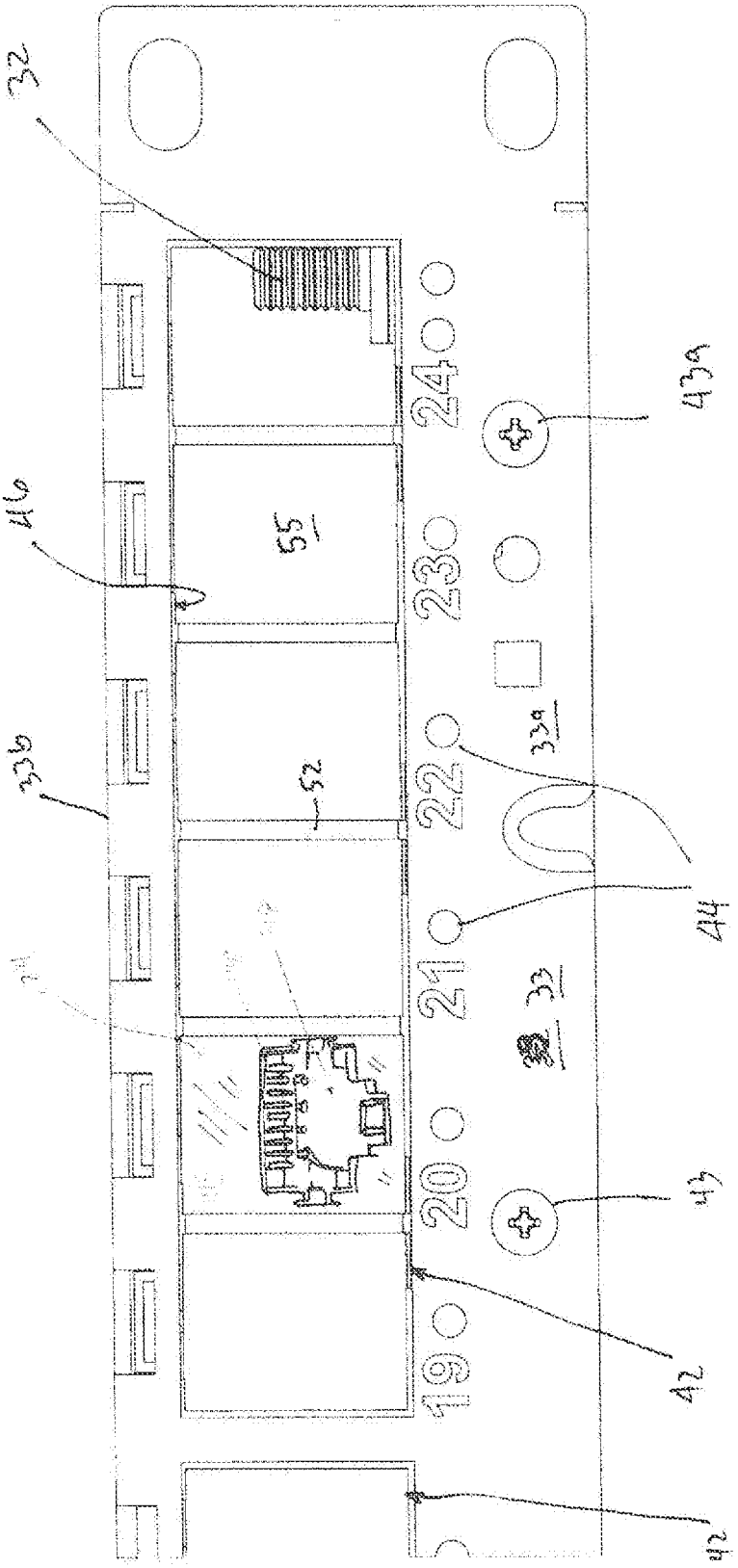


Fig. 4

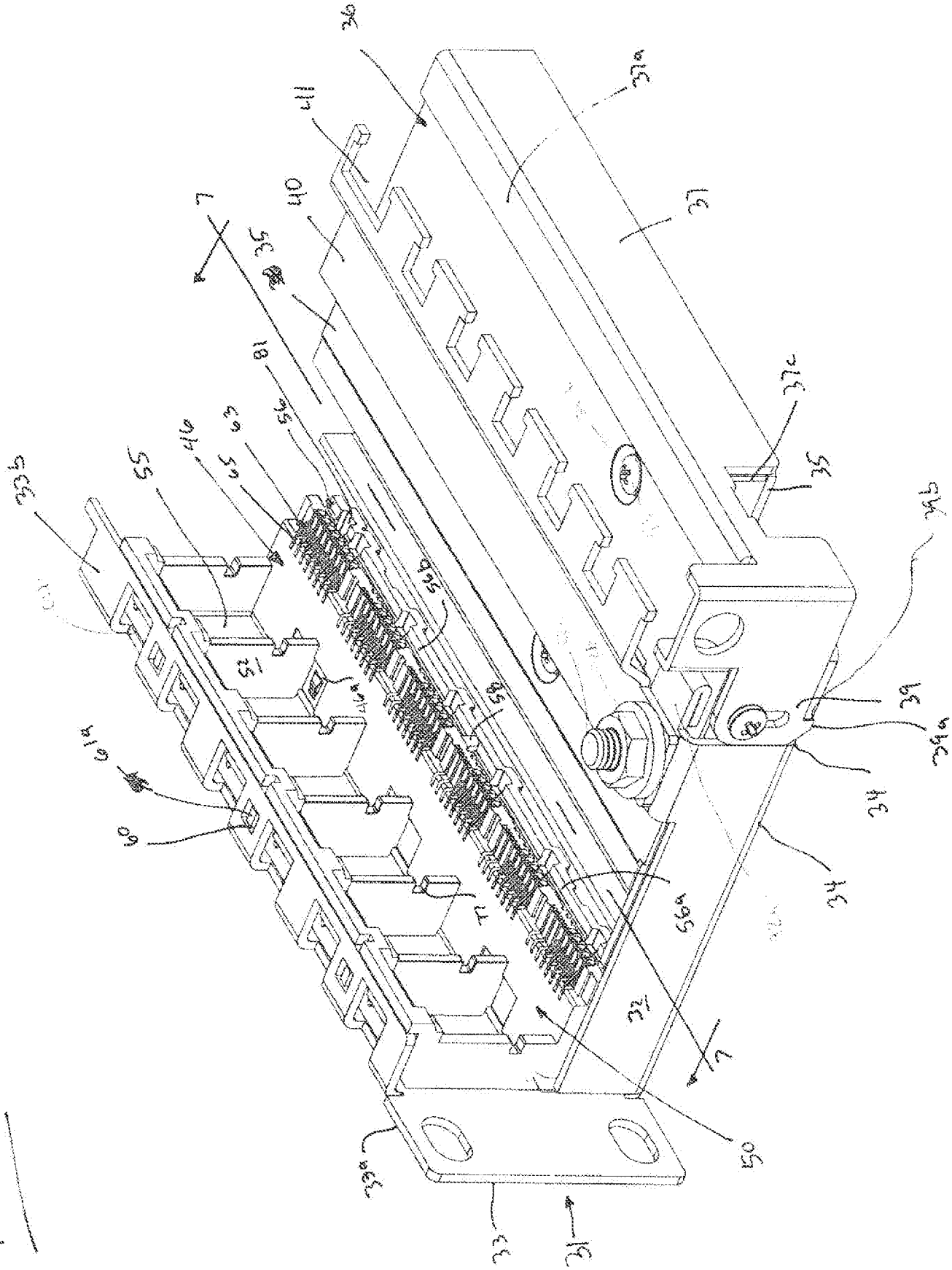


Fig. 5

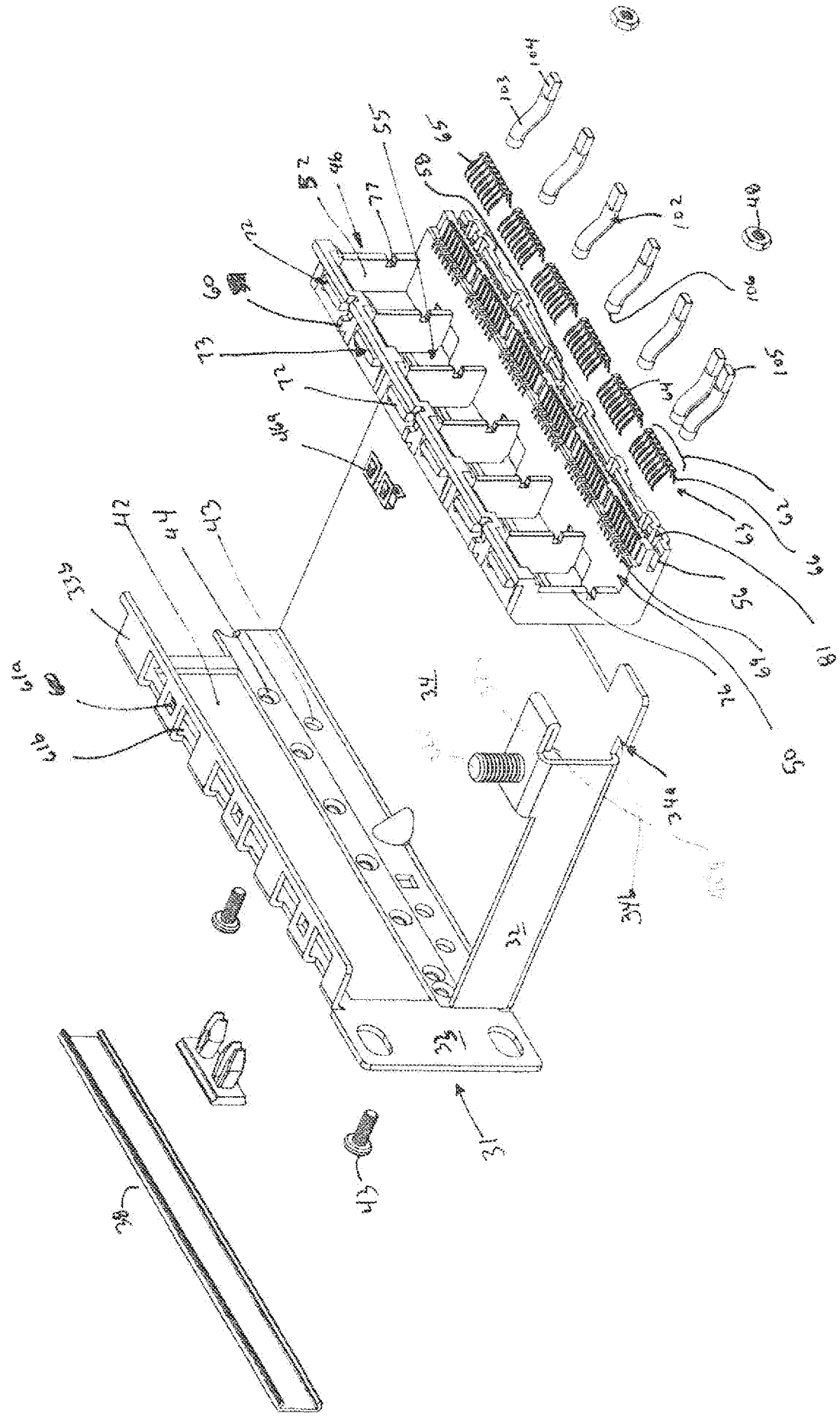
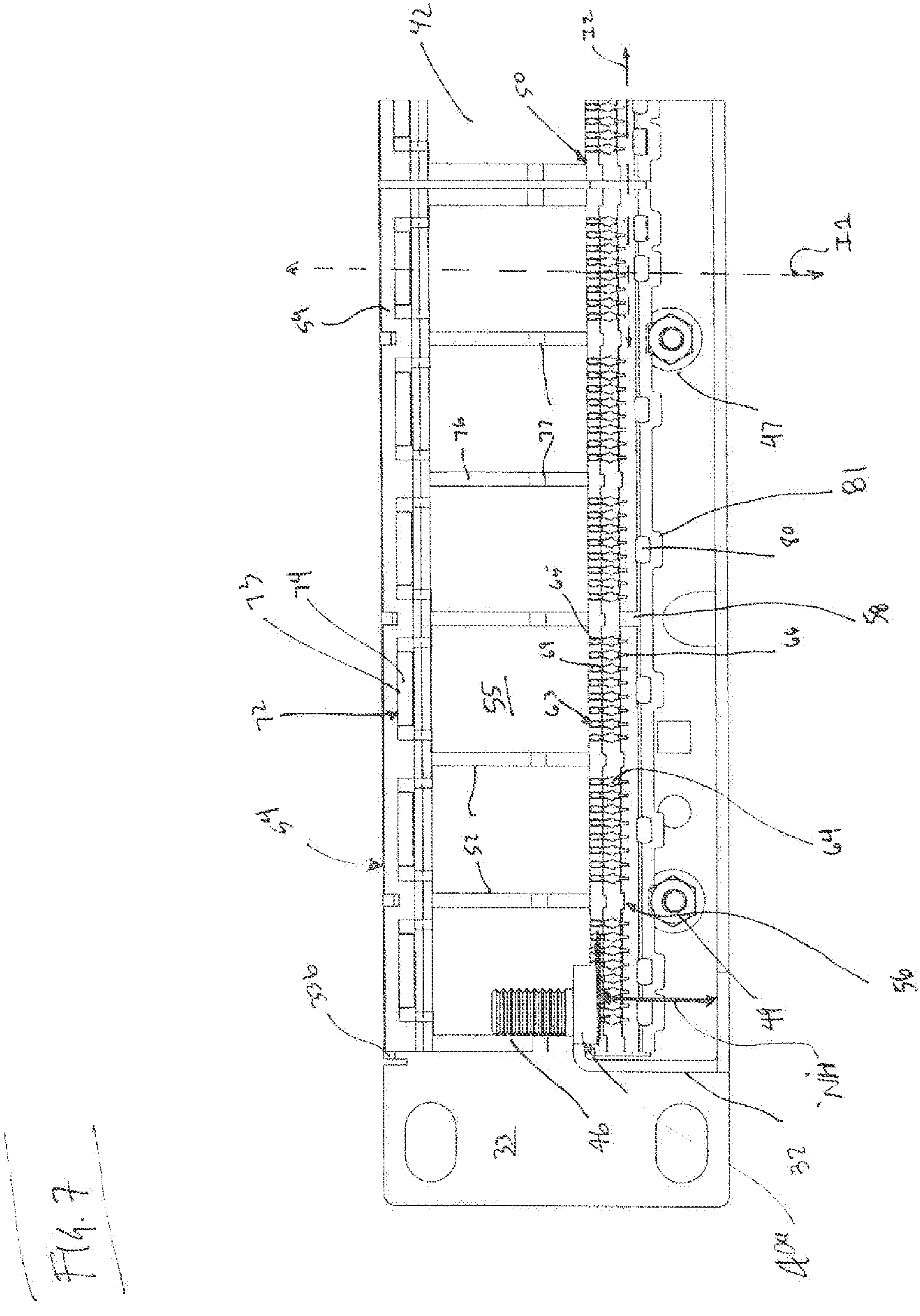


FIG. 6



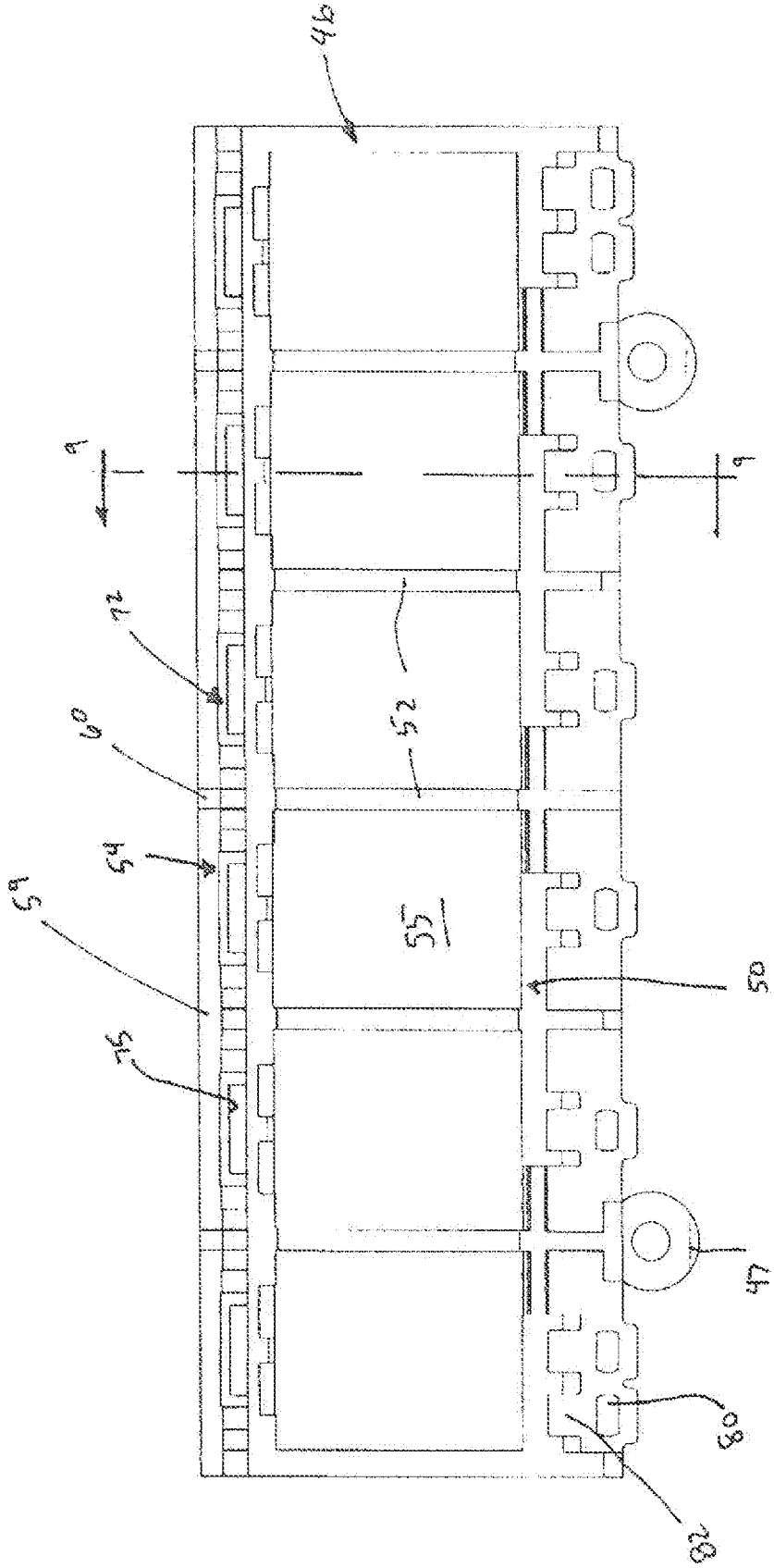


FIG. 6

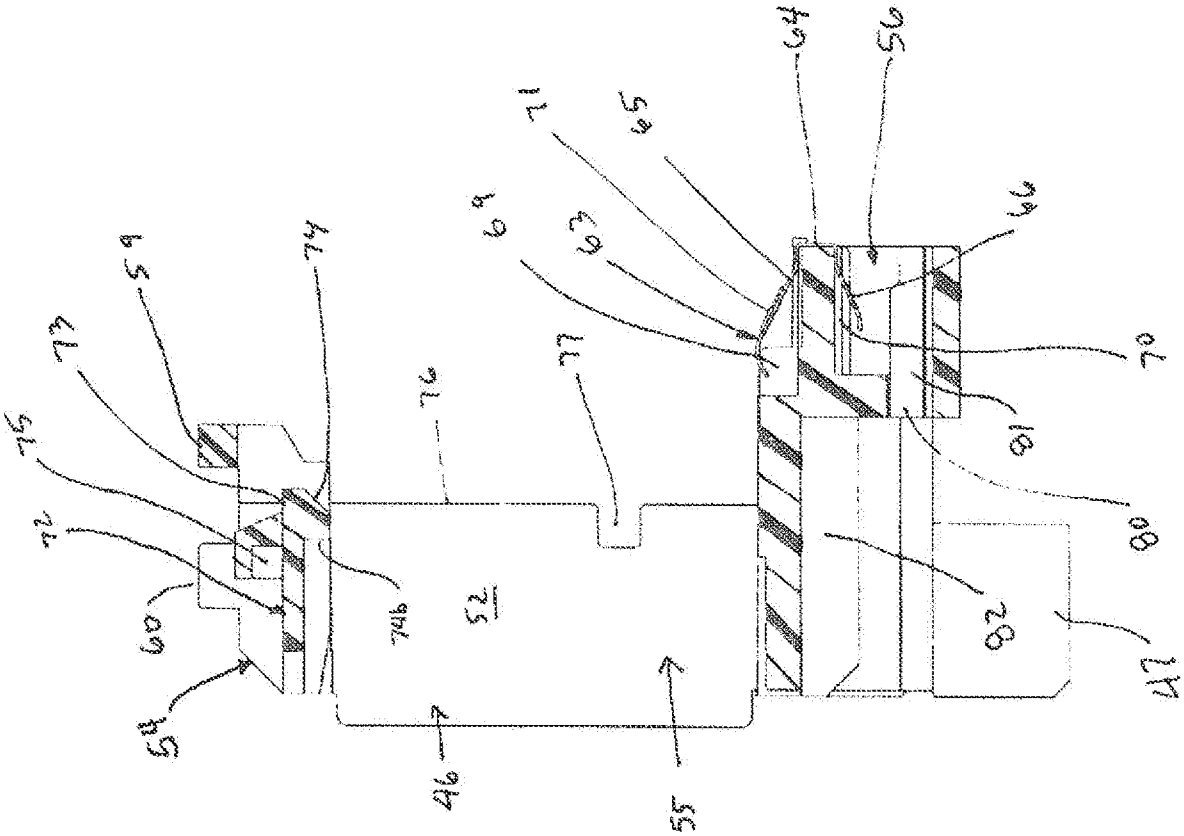


FIG. 1

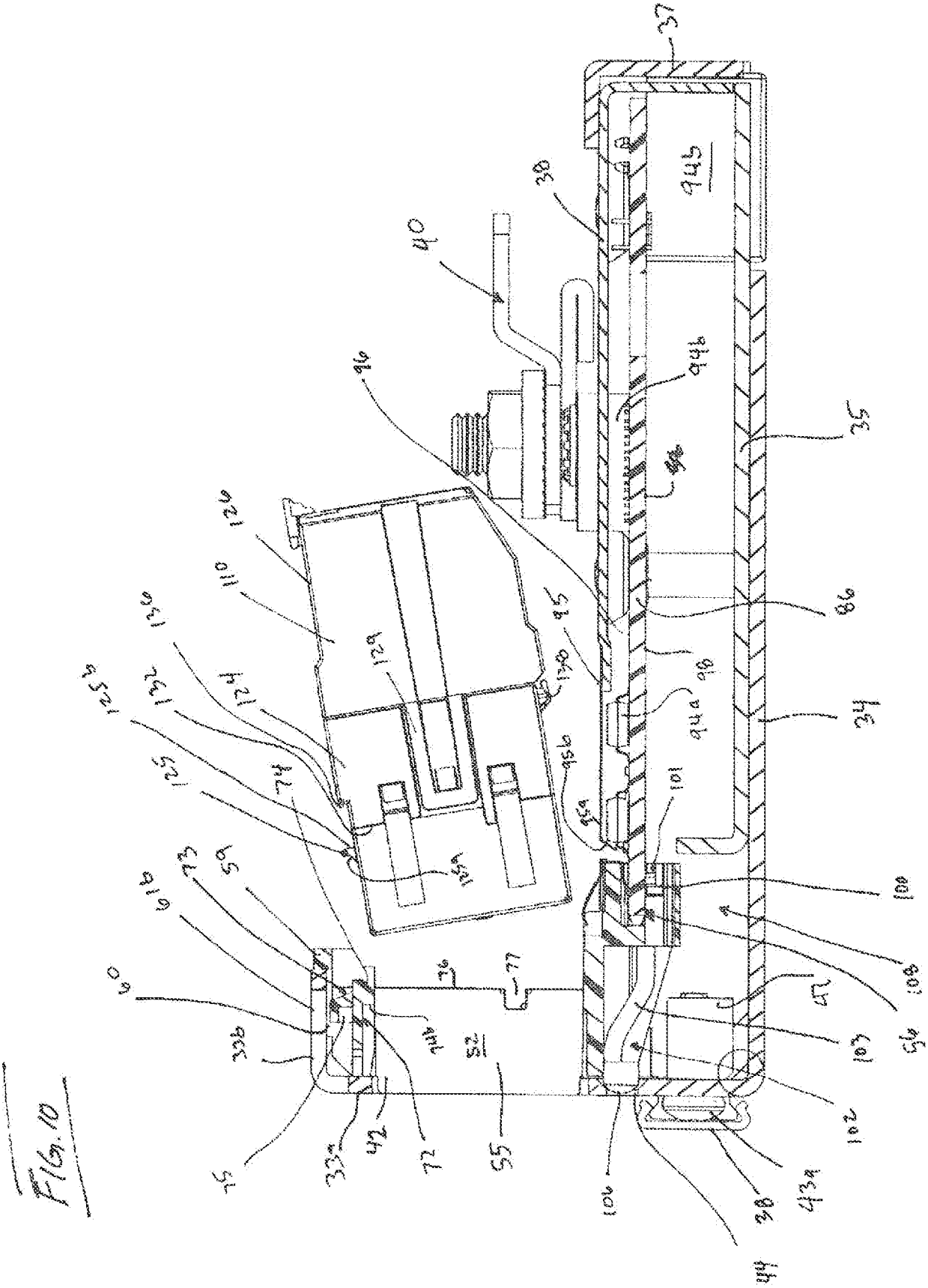


Fig. 10

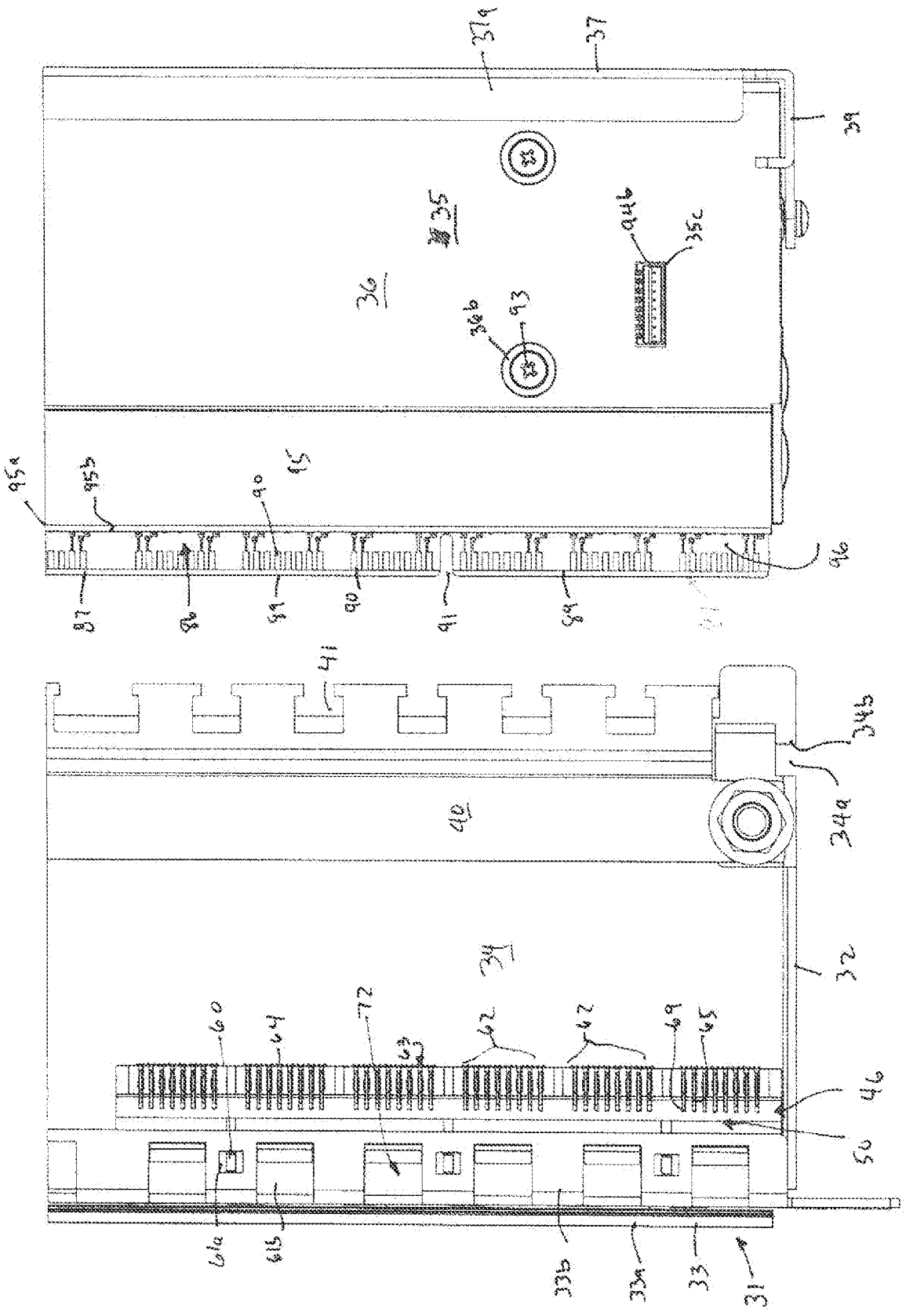

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FIG. 11

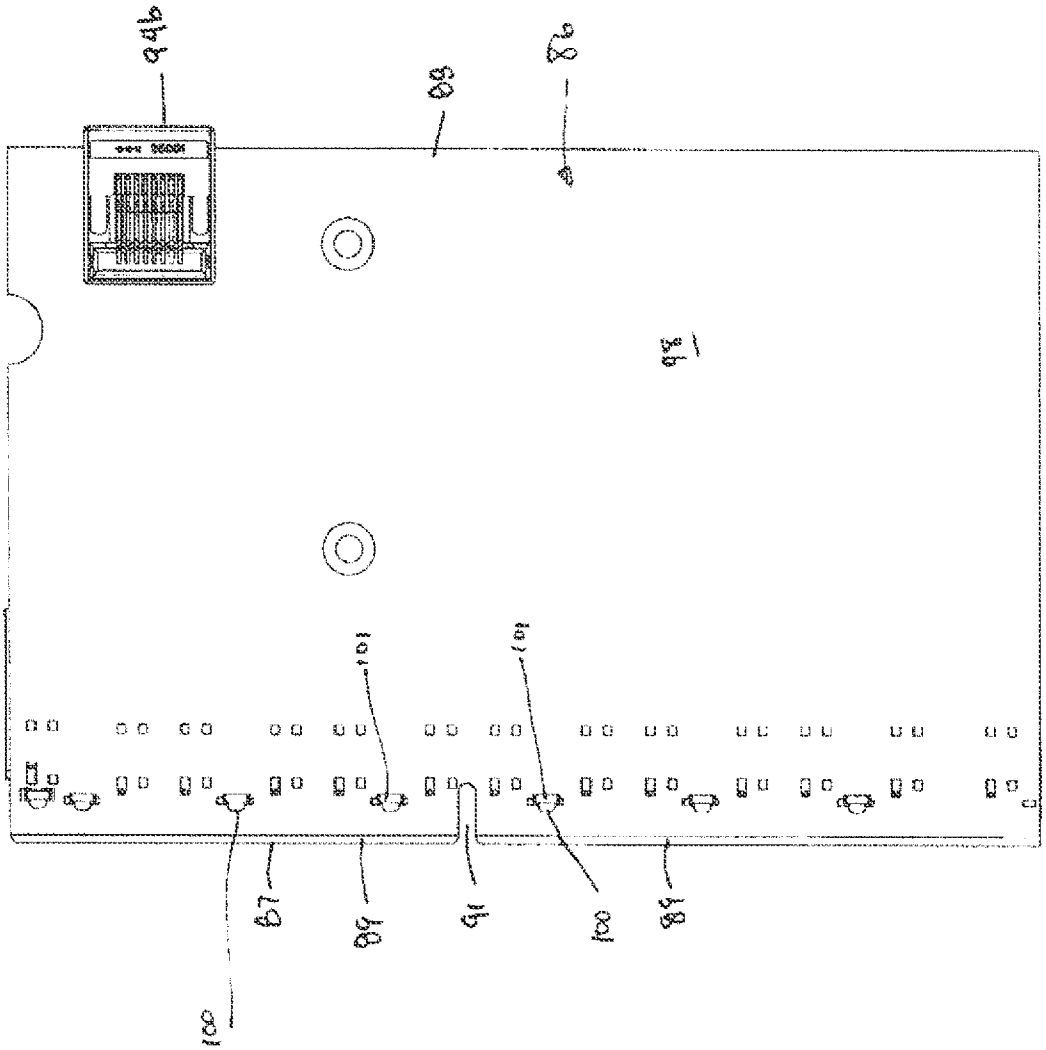

FIG. 12

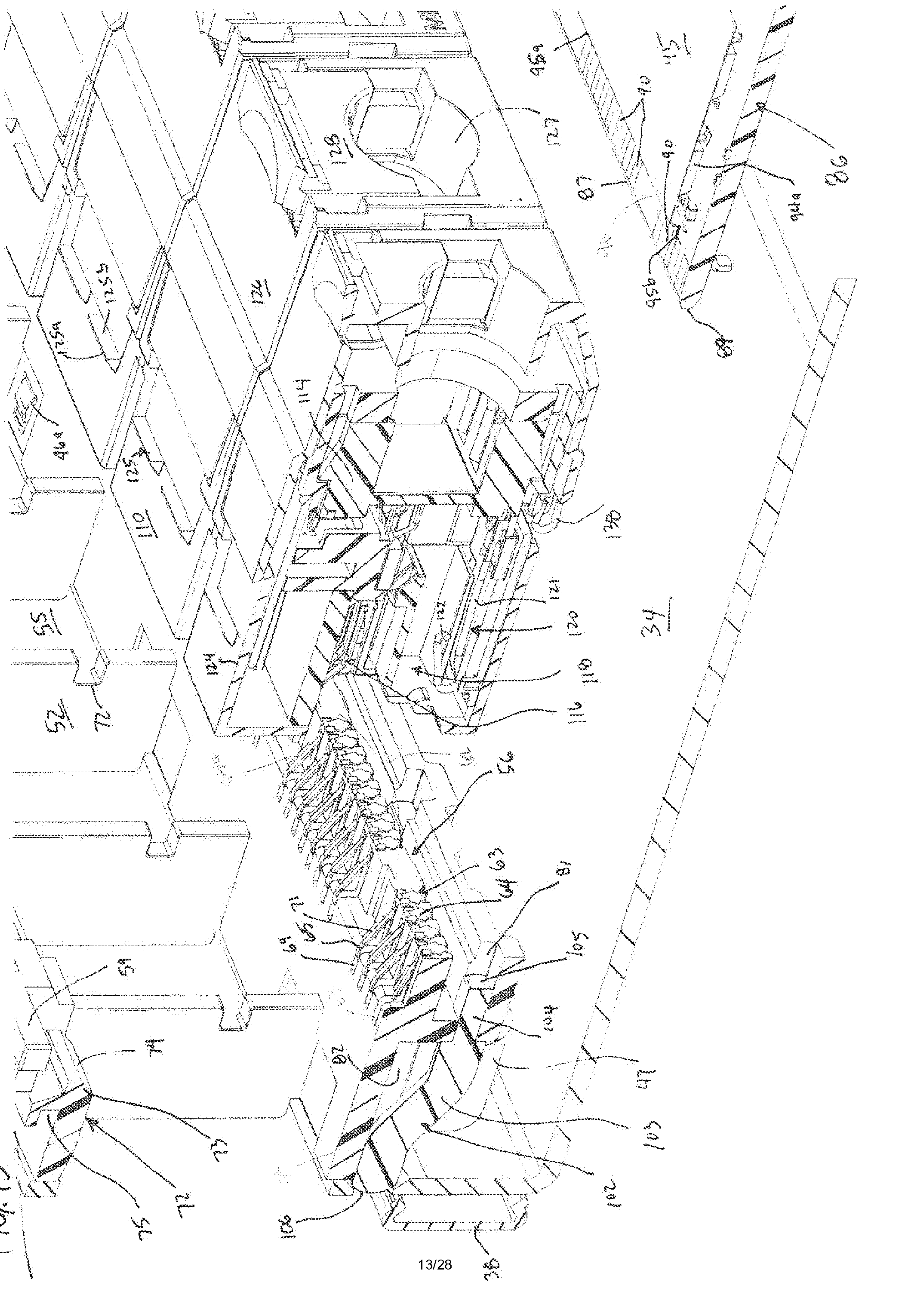

FIG. 13

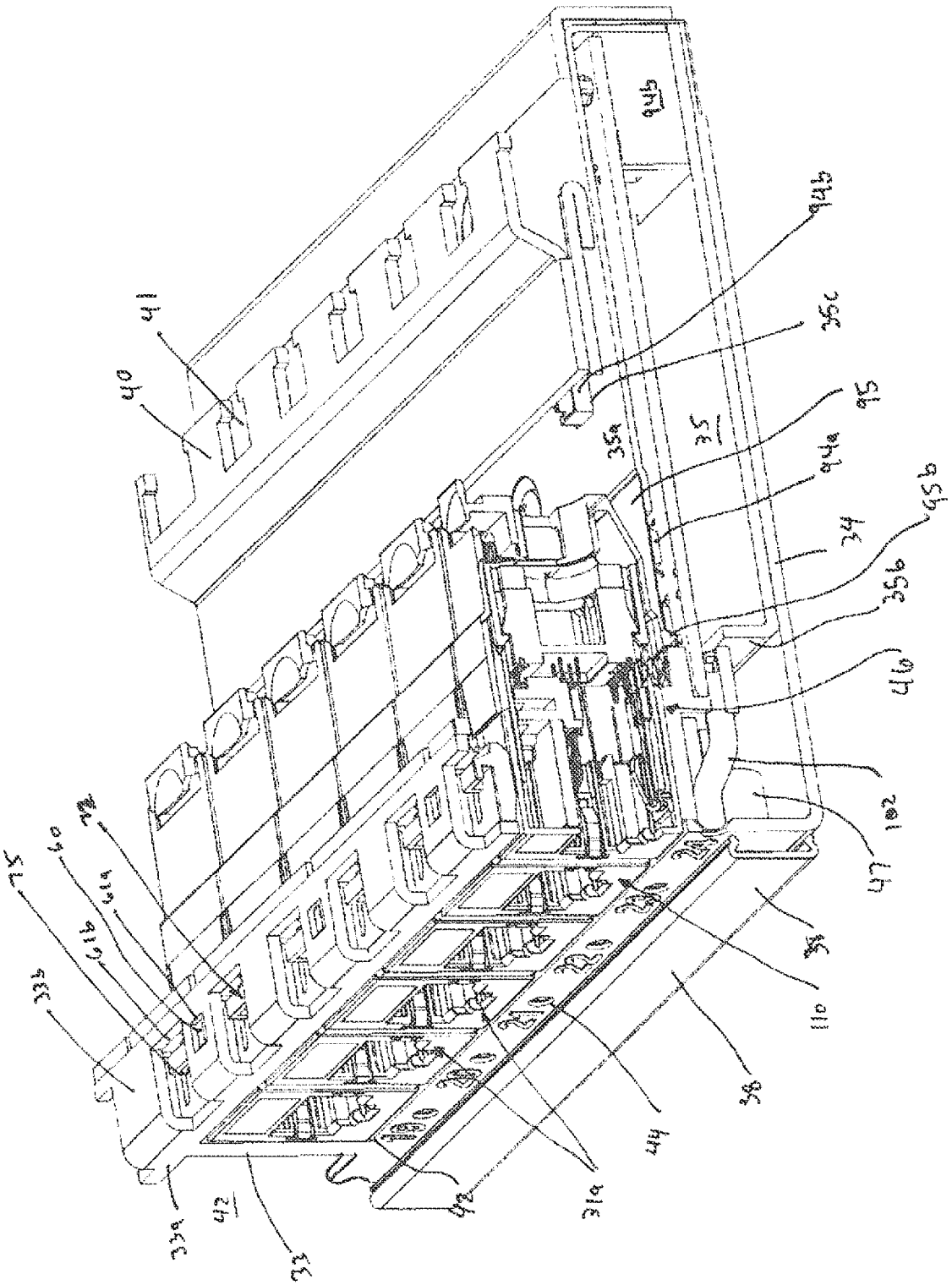

FIG. 14

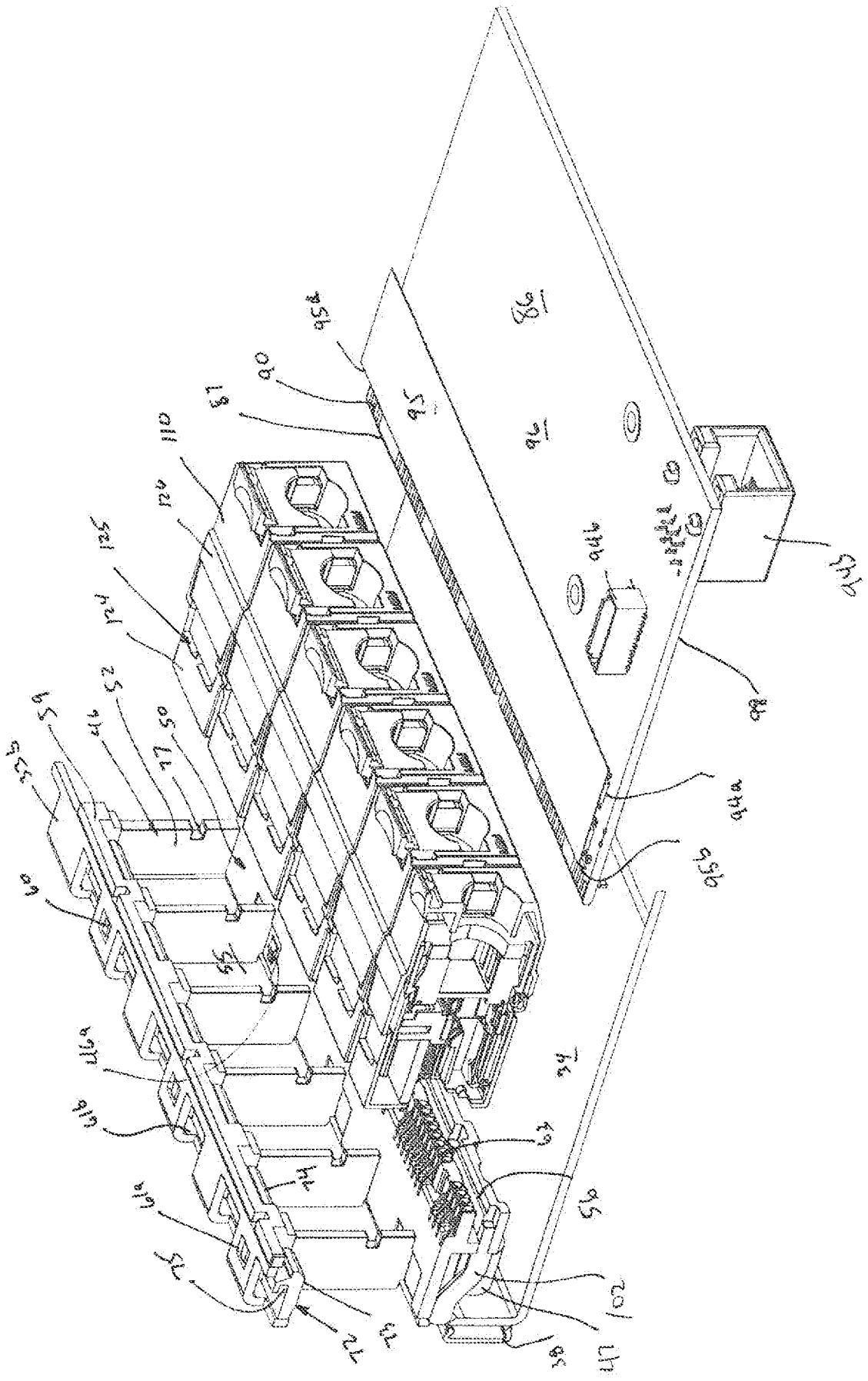

Fig. 15

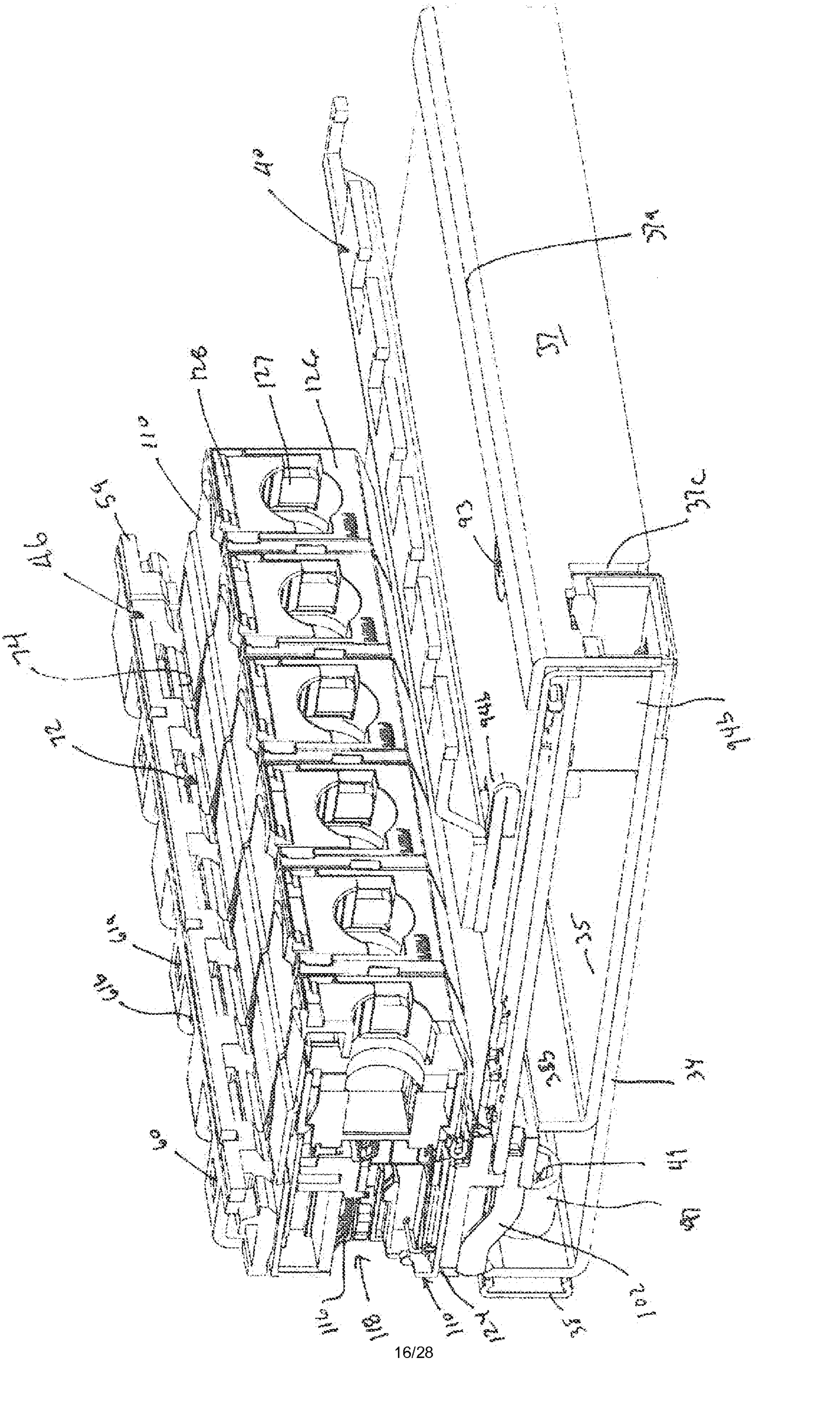

FIG.16

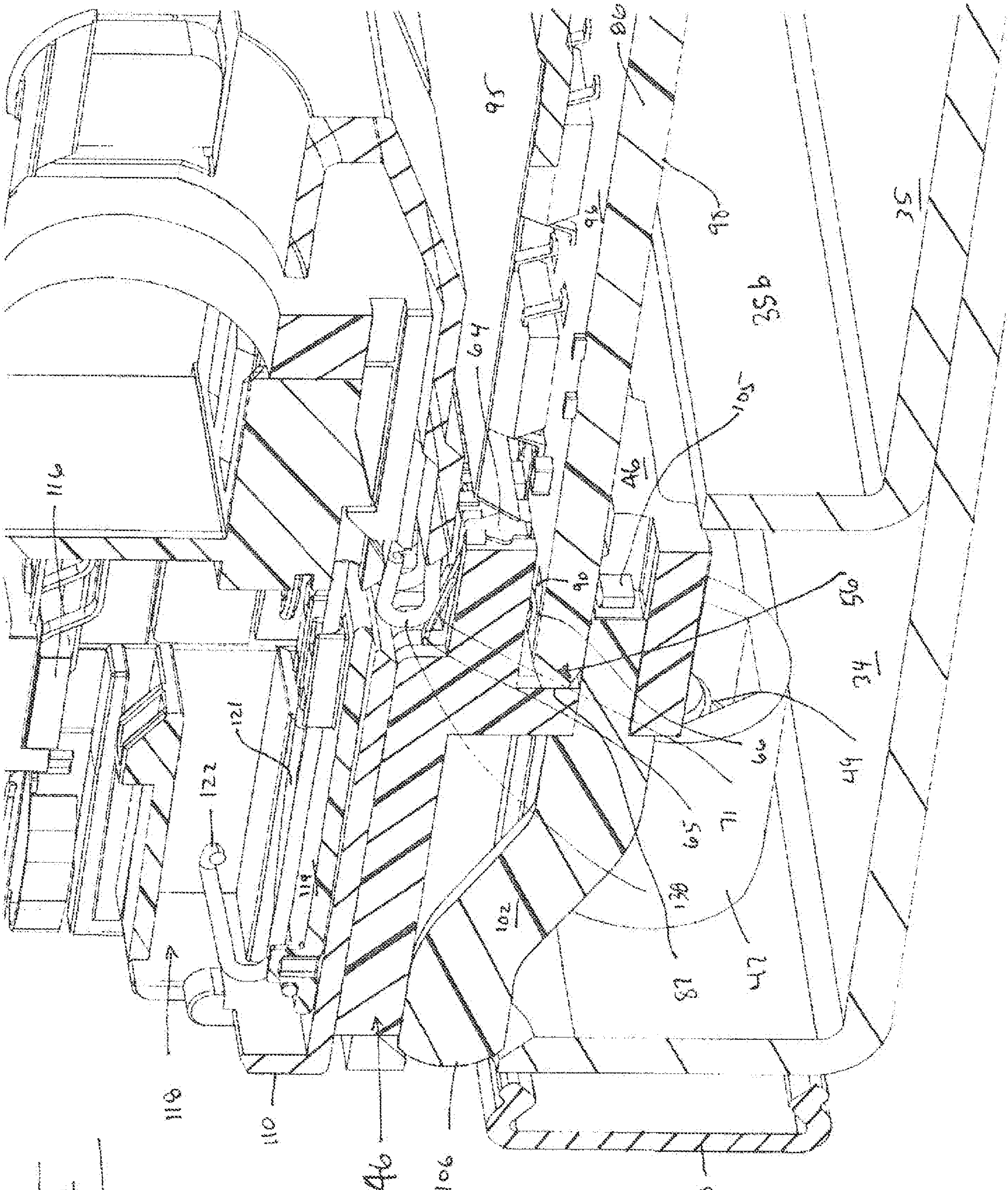
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Fig. 17

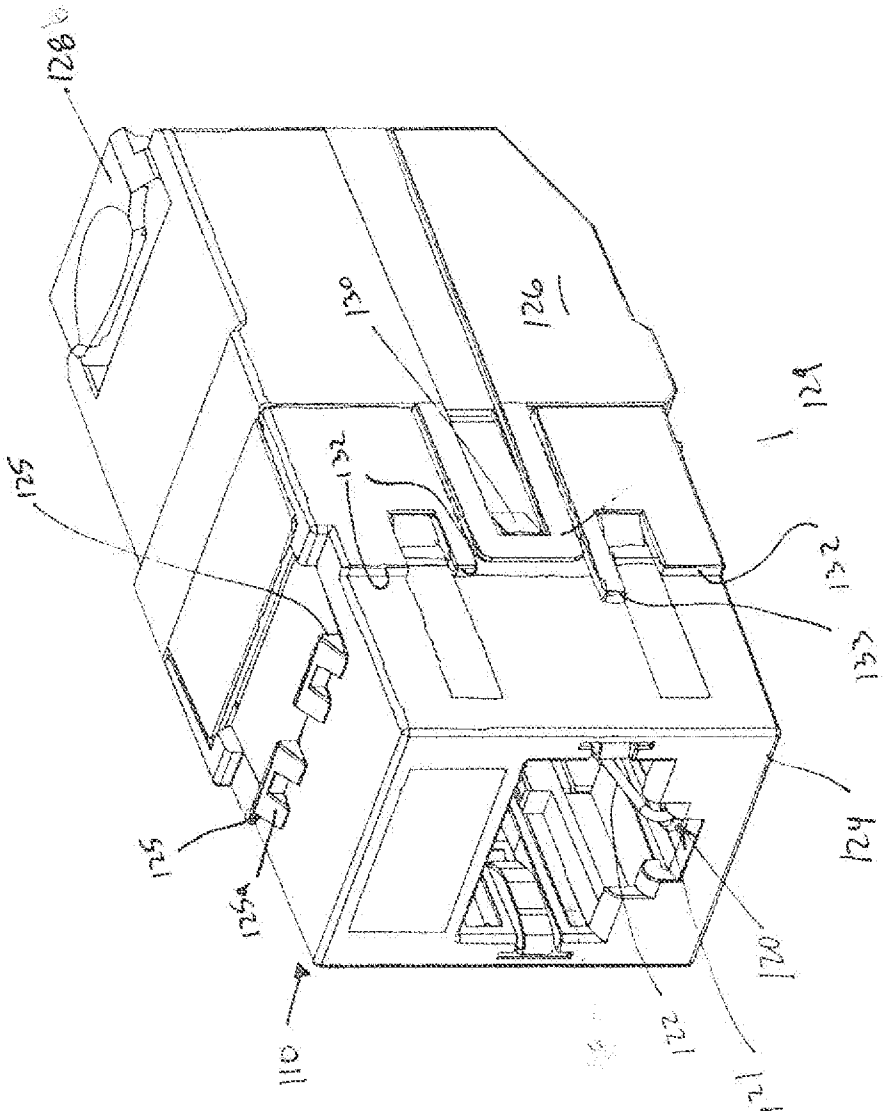

FIG. 1B

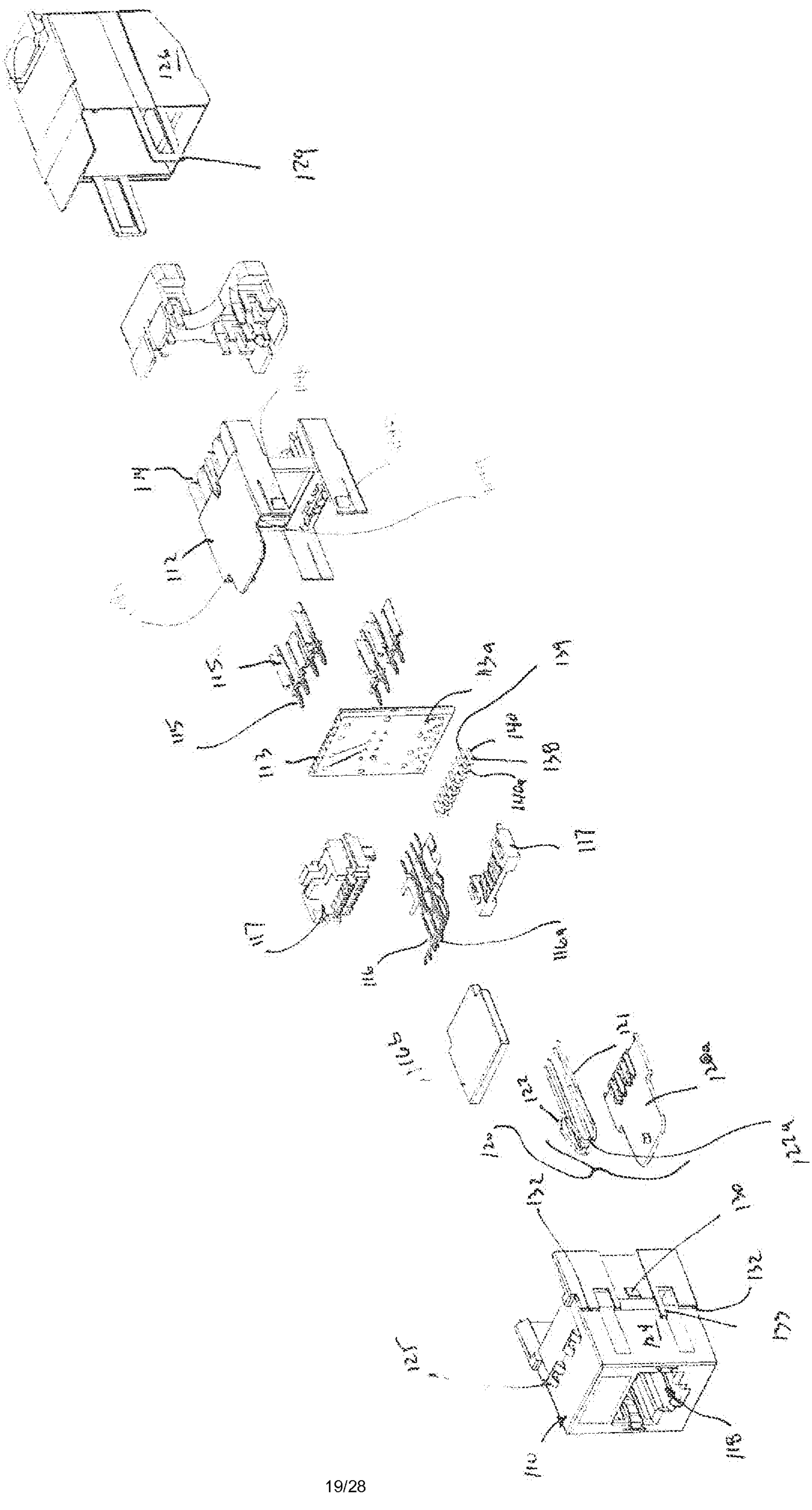

FIG. 19

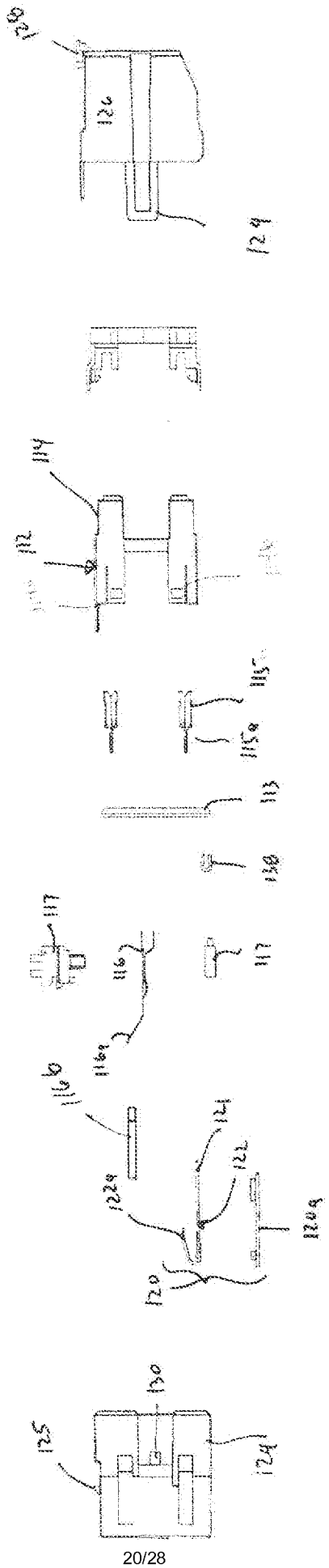

FIG. 20

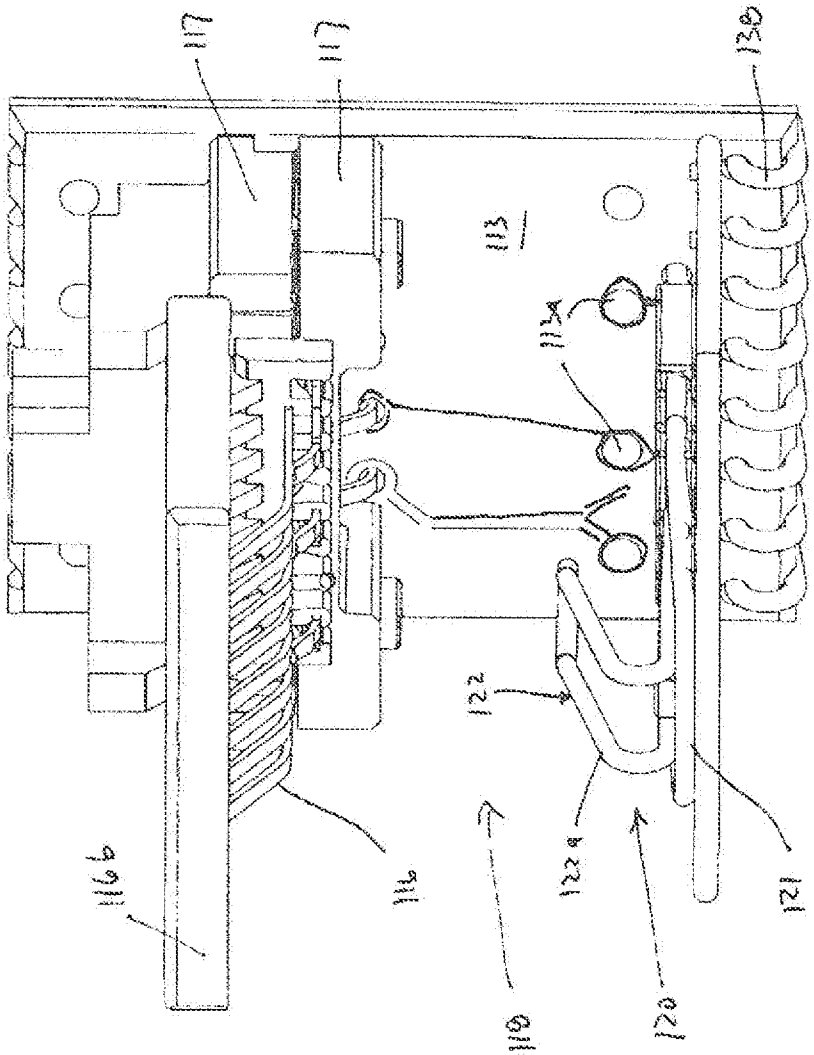

FIG. 21A

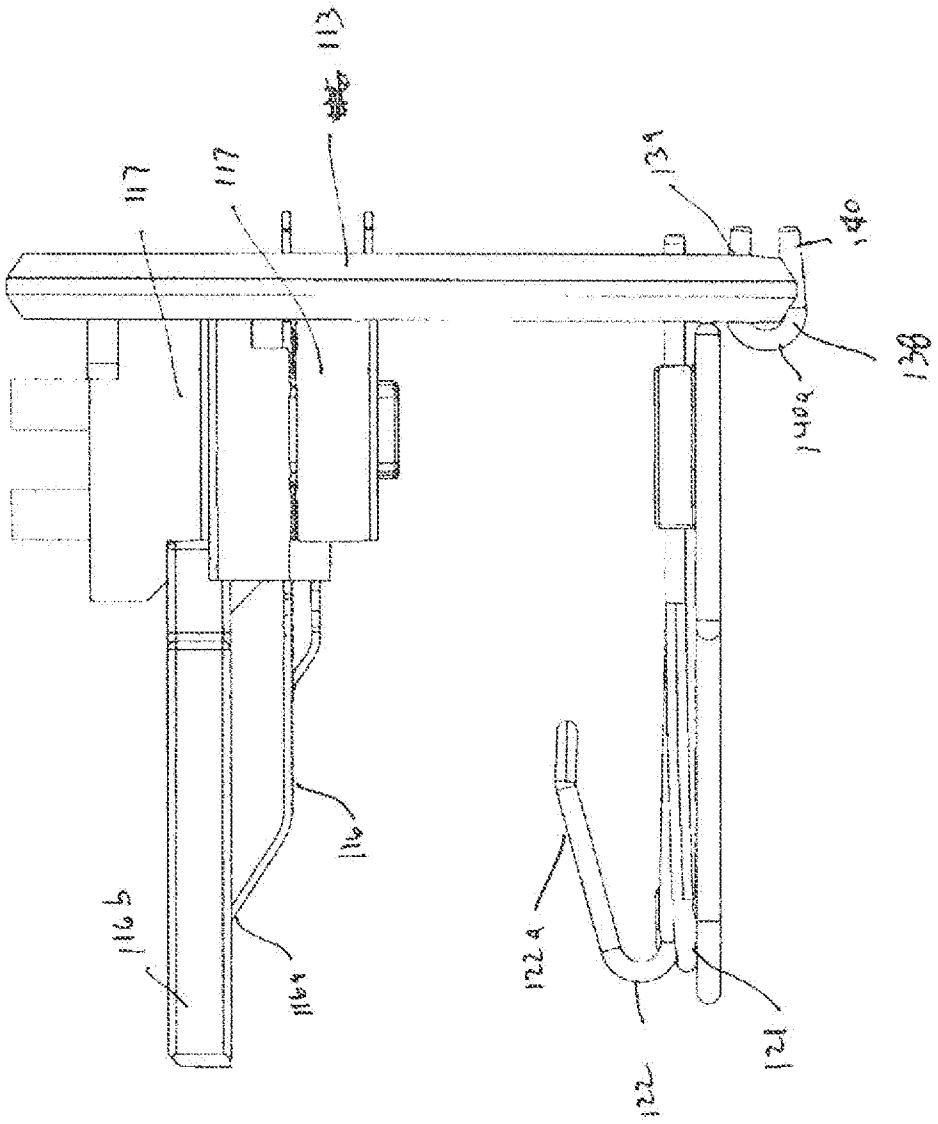

FIG. 21B

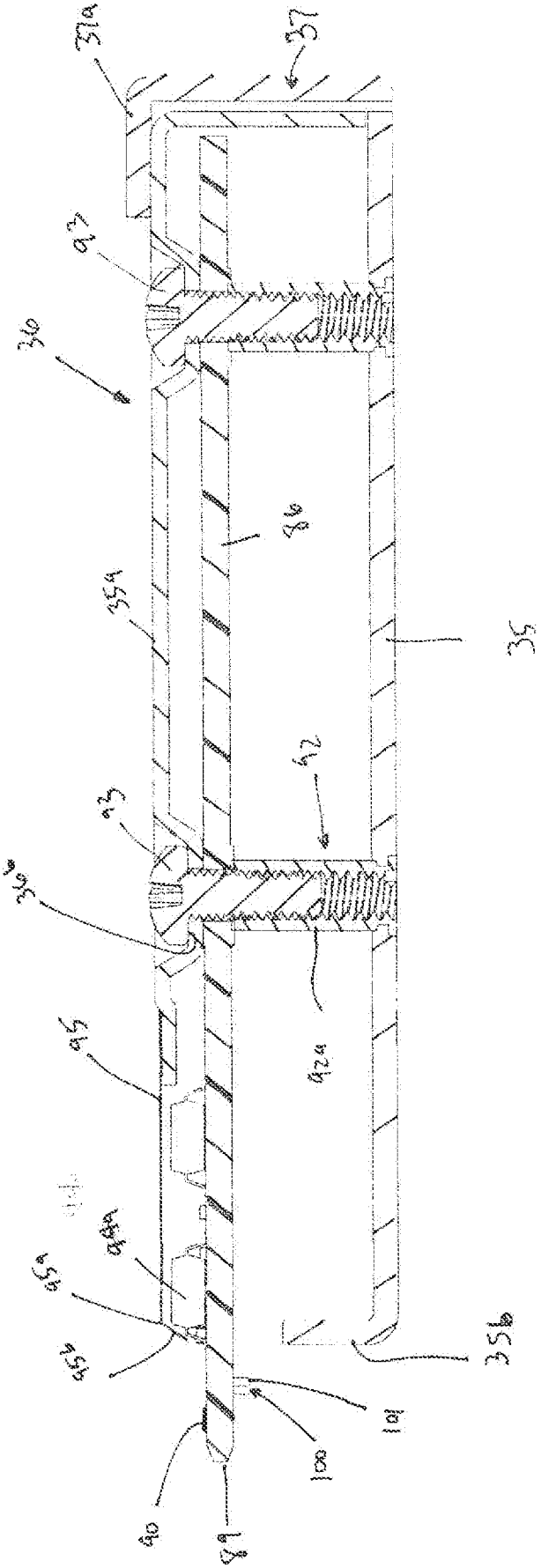

FIG. 22A

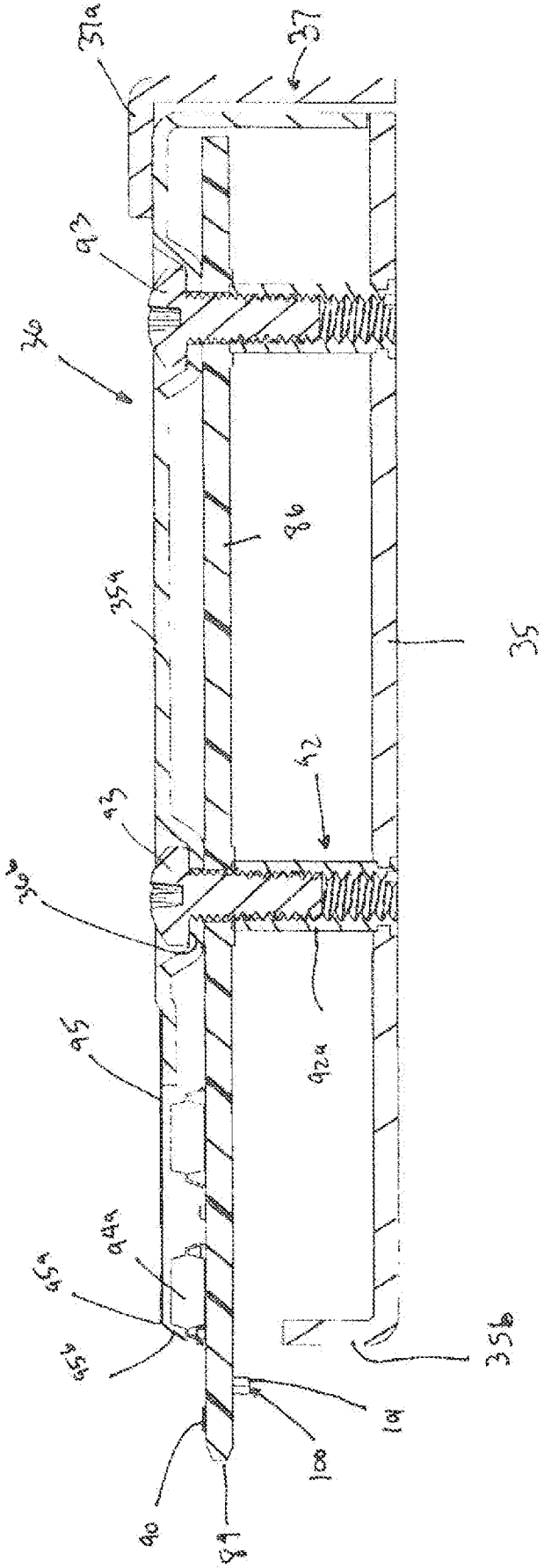

FIG. 22A

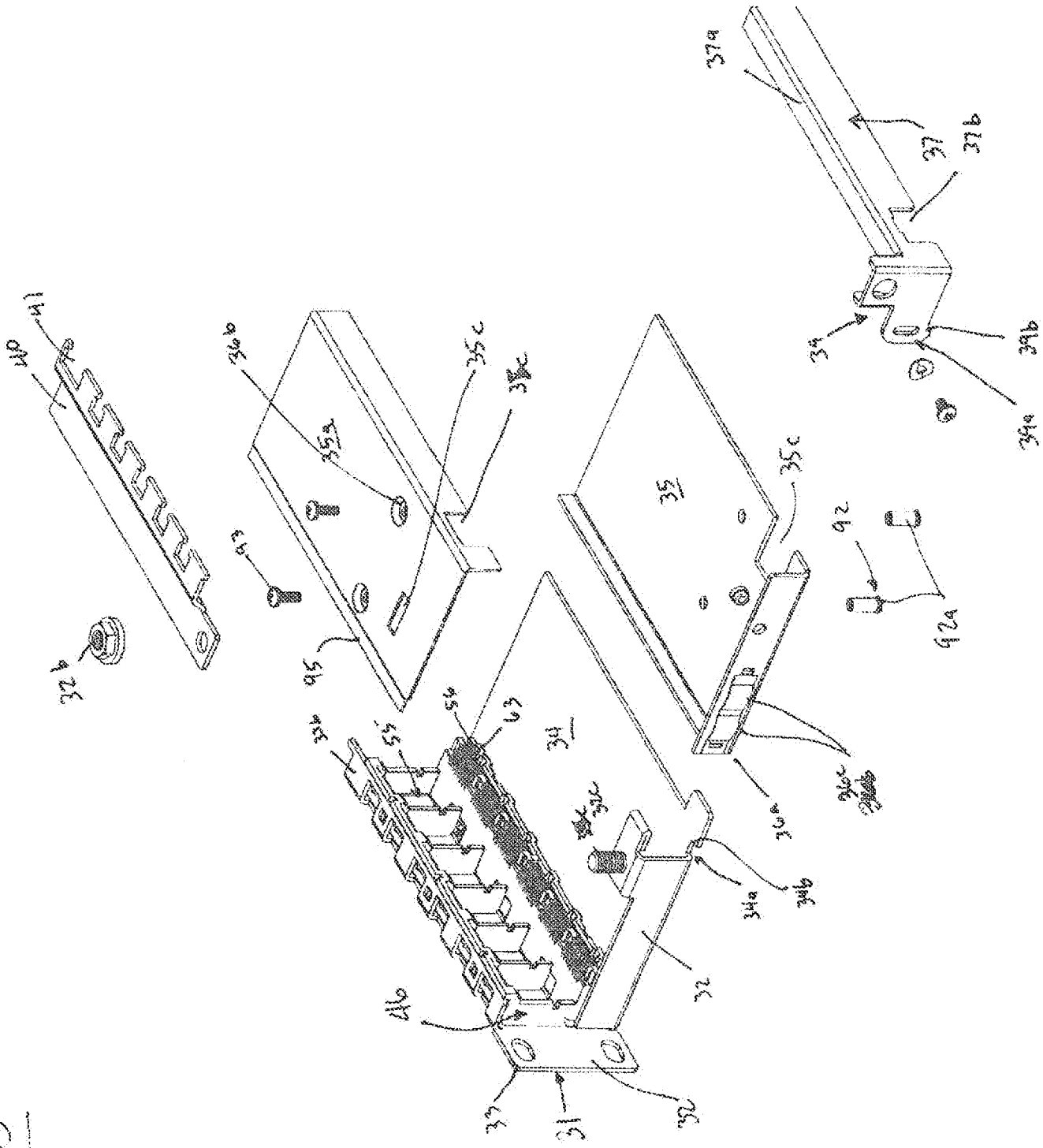

Fig. 23

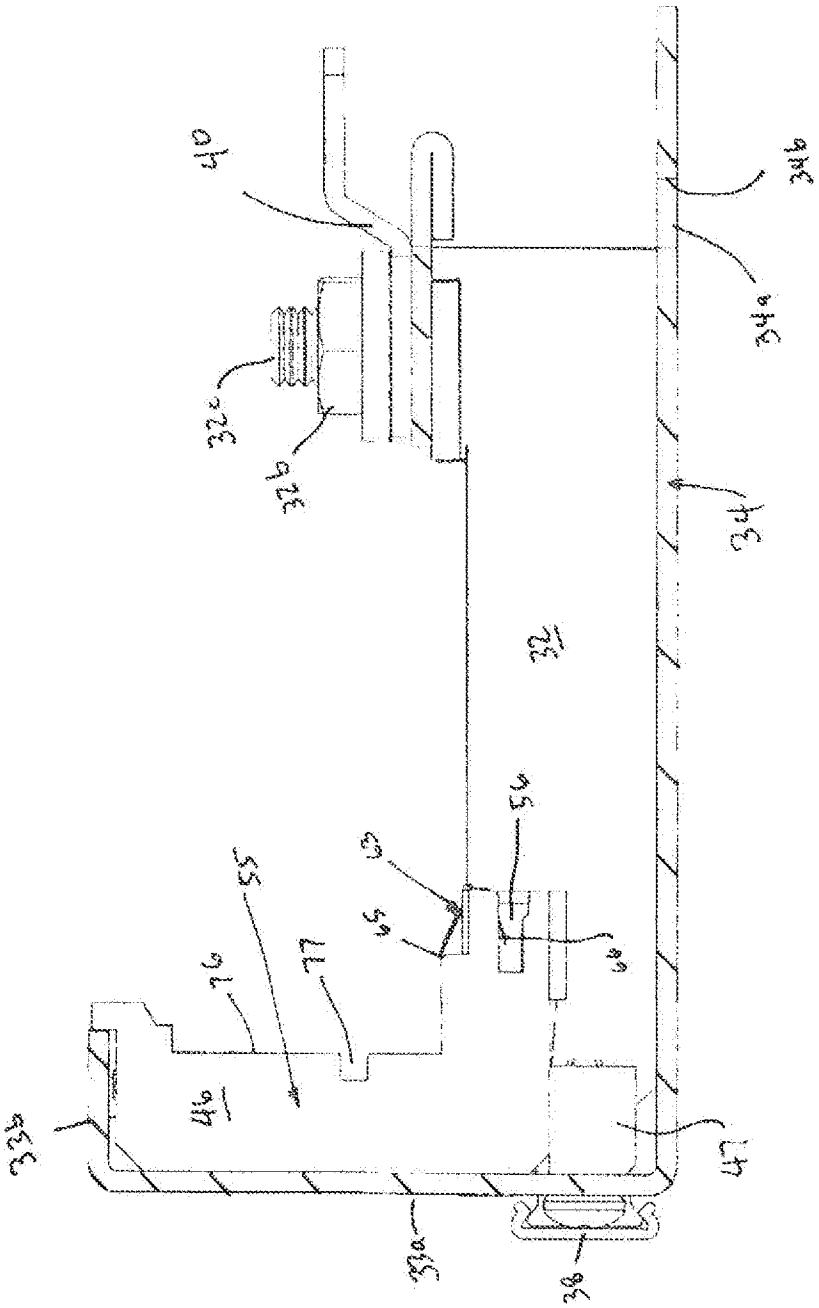

Fig. 24A

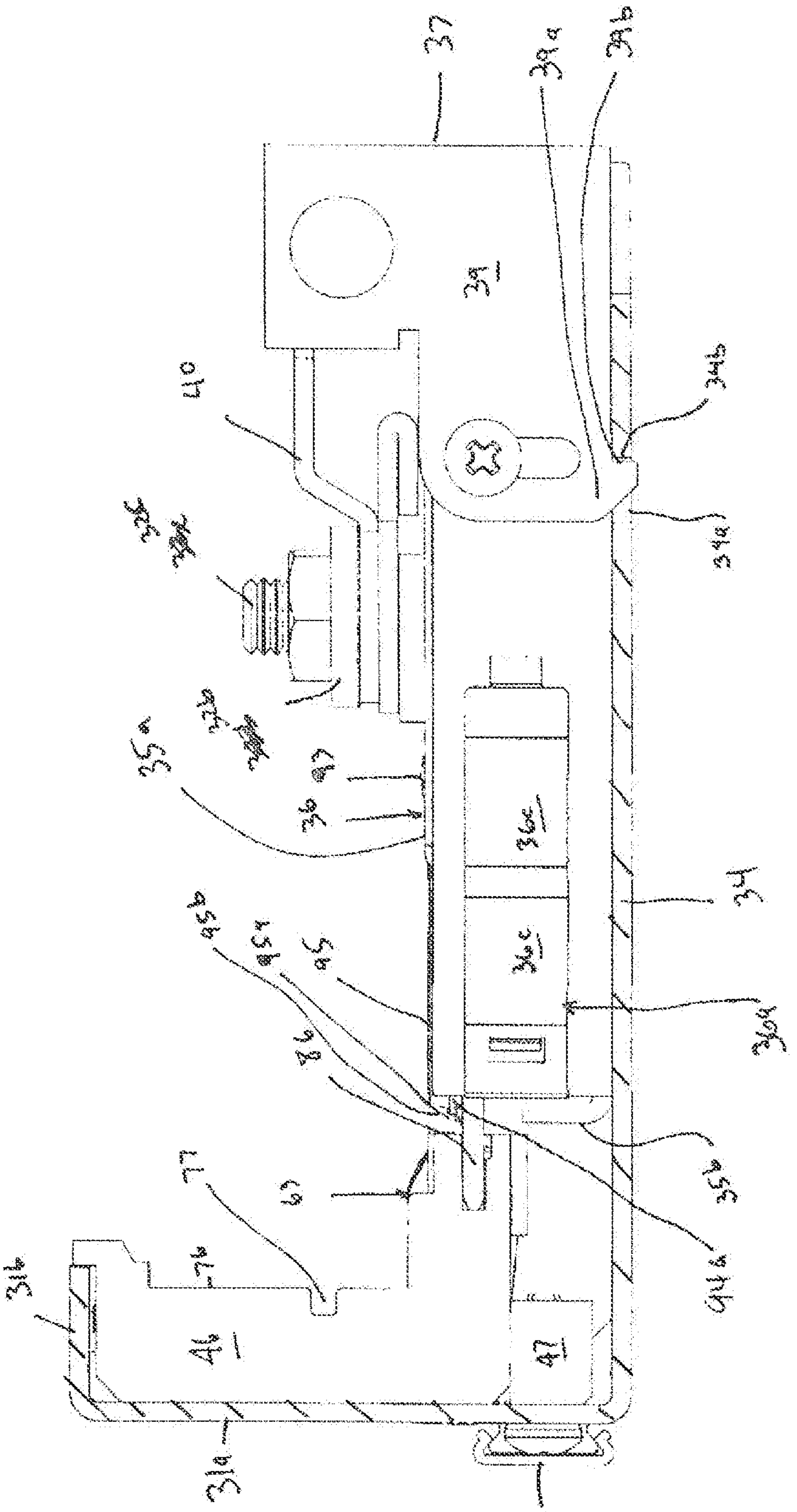

FIG. 24B

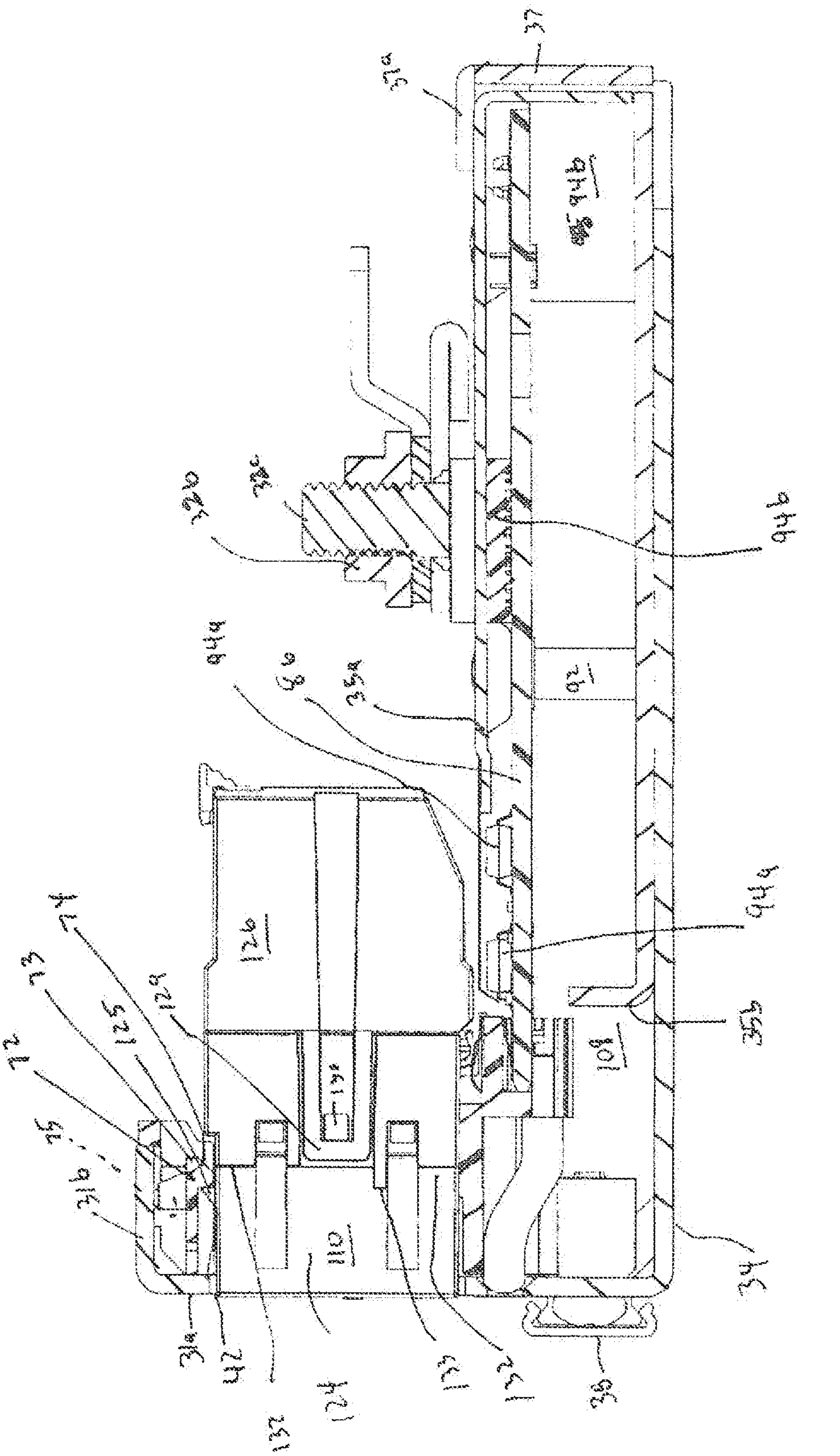
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Fig. 24C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/043831

A. CLASSIFICATION OF SUBJECT MATTER

H01R 9/24(2006.01)i, H01R 24/64(2011.01)i, H01R 13/74(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01R 9/24; H01R 13/46; H01R 29/00; G06F 15/173; H05K 3/30; H01R 24/00; G02B 6/00; H02B 1/015; H01R 24/64; H01R 13/74

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: communication, connector, patch panel, jack, housing, slot, LED

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7207846 B2 (JACK E. CAVENEY et al.) 24 April 2007 See column 5, line 53 - column 8, line 5, column 9, lines 7-13; and figures 1-2, 5a-9, 11-12.	1-174
A	US 2013-0217249 A1 (PANDUIT CORP.) 22 August 2013 See paragraph [0046]; claim 11; and figure 2A.	1-174
A	US 2012-0226807 A1 (AUGUSTO P. PANELLA et al.) 06 September 2012 See paragraphs [0029]-[0030]; and figure 4.	1-174
A	US 2012-0244752 A1 (SATISH I. PATEL et al.) 27 September 2012 See paragraphs [0049]-[0055]; claim 1; and figures 2-12.	1-174
A	US 2014-0037259 A1 (CHARLES R. BRAGG) 06 February 2014 See paragraphs [0081]-[0088]; and figures 1A-1E, 6-7.	1-174

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 November 2015 (19.11.2015)	**19 November 2015 (19.11.2015)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
PARK, Hye Lyun
Telephone No. +82-42-481-3463

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2015/043831

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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