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(54) **SPLICED PIN BLOCK FOR MODULAR CONNECTORS**

(57) Pin block module for insertion into a housing of a modular connector, the pin block module comprising a pin block support having a first connection surface and an opposing second connection surface, at least two pins extending through the pin block support such that each

pin protrudes from the first connection surface and from the second connection surface, the pin block module further comprises at least one splice element connecting the at least two pins to each other to splice them.

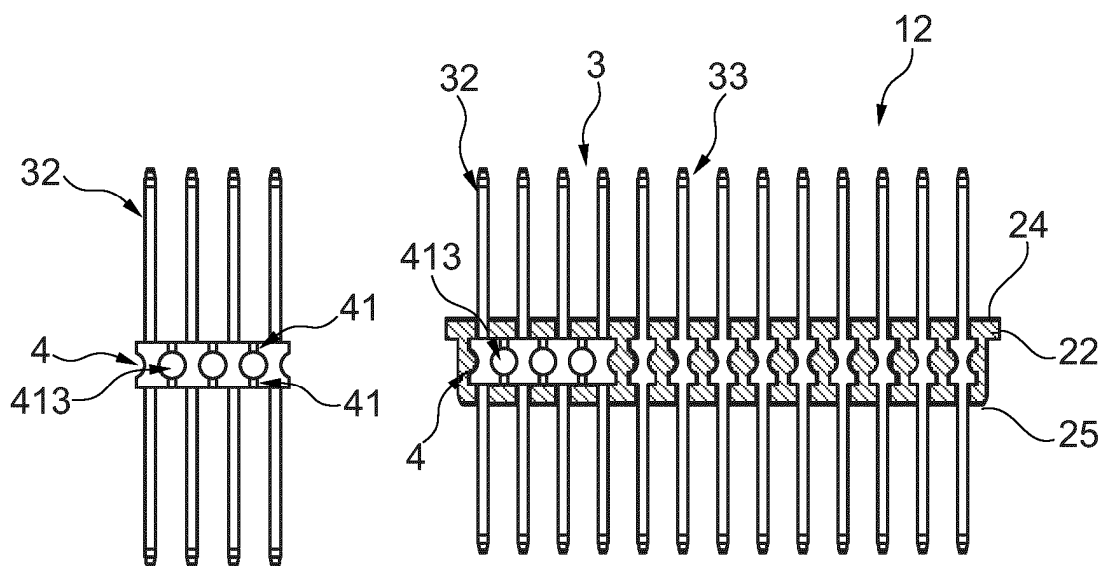


Fig. 5

Description

1. Field of the invention

[0001] The present disclosure relates to a pin block module for use in modular connectors. Specifically, the present disclosure pertains to a pin block module designed for insertion into a connector housing, featuring a pin block support with pins.

2. Prior art

[0002] In the field of modular connectors, it is common to use pin block modules for establishing electrical connections within a housing. These pin block modules typically involve multiple pins that extend through a support structure, allowing for connections on both sides of the module. Known systems often require the use of separate connectors and terminals to splice multiple pins together. This approach can be cumbersome and inefficient, as it necessitates additional components and assembly steps.

[0003] Previously, splicing pins when using a pin block module necessarily involved the use of external devices such as external splice savers or connectors, welded splices or crimped splices. These external devices are designed to connect multiple pins together, but they require separate terminals and additional wire lengths to achieve the desired connections. This not only increases the complexity of the assembly process but also adds to the overall size and weight of the connection. Furthermore, the additional wire lengths can introduce potential points of failure and reduce the reliability of the electrical connections.

[0004] Despite the substantial advances in the field of modular connectors, there remains a need for improved pin block modules that can provide reliable splicing of multiple pins without the drawbacks associated with separate connectors and additional wire lengths. The current methods of using external splice savers and terminals are not only inefficient but also prone to issues such as increased assembly time, higher manufacturing costs, and potential reliability concerns.

[0005] It is therefore a technical problem underlying the present invention to provide a pin block module that at least partially overcomes the disadvantages of known systems.

3. Summary of the invention

[0006] It is an object of this invention to provide a pin block module that overcomes one or more of the disadvantages of known systems.

[0007] The above-mentioned object is at least partially realized by a pin block according to claim 1.

[0008] A first aspect of the invention provides pin block module for insertion into a housing of a modular connector, the pin block module comprising a pin block

support having a first connection surface and an opposing second connection surface, at least two pins extending through the pin block support such that each pin protrudes from the first connection surface and from the second connection surface. This configuration allows for electrical connectivity through the pin block support.

[0009] The pin block module further comprises at least one splice element connecting the at least two pins to each other to splice them. In other words, the splice element serves to connect the at least two pins to each other, creating a jumper or wire bridge thus effectively splicing them. Thus, the pins are electrically connected allowing e.g., a signal introduced into one (signal entry) pin to be effectively transmitted to two (signal outlet) pins.

The splice element provides an integrated solution for connecting the pins, which can enhance the reliability and efficiency of the connection by reducing the need for separate connectors, terminals, and additional wire lengths. This integration can lead to a more compact and streamlined design, improving the ease of assembly and reducing the overall complexity of the modular connector system. The use of a splice element e.g., within the pin block module may also facilitate better electrical performance and durability by minimizing potential points of failure associated with traditional splicing methods.

[0010] The term "pin block module" refers to a component used in modular connectors, which are devices that allow for the connection and disconnection of electrical circuits. The pin block module is a part of the connector system that houses pins or terminals used for making electrical connections. The "splice element" is a component that joins or connects pins within the module, allowing for example the integration of multiple wires into a single connection point, or vice versa. The "pin block support" is the structural part of the module that holds and supports the pins and splice elements.

[0011] Advantageously the at least one splice element is arranged inside the pin block support. By arranging the splice element inside the pin block support, the design allows for a more compact and integrated configuration. Additionally, this configuration may contribute to a cleaner and more efficient layout.

[0012] Example embodiments include that the at least two pins and the splice element are integrally formed. This means that the pins and the splice element are manufactured as a single piece, rather than being separate components that are later assembled. This integration can enhance the structural integrity and reliability of the pin block module by reducing the number of parts and potential points of failure. It also simplifies the manufacturing process, potentially lowering production costs and improving consistency in the final product. The integral formation ensures a seamless connection between the pins and the splice element, which is inherently more robust than the connection between separate components. This can lead to improved electrical performance and durability, as there are no joints or interfaces that could degrade over time. It also brings significant advantages

tages in terms of manufacturing efficiency, structural integrity, and overall reliability of the pin block module.

[0013] In some embodiments where the pins are to be stitched into the pin block support and where the pins and the splice element are integrally formed, the splice element is advantageously formed such that the at least two pins can be stitched into the pin block support and the splice element is received within the pin block support, i.e. without the splice element protruding from the pin block support.

[0014] The term "stitched" refers to the method of securing the pins into the support, which involves a precise insertion technique that ensures stability and alignment. The advantage of this design is that it maintains a streamlined profile, preventing any part of the splice element from extending beyond the boundaries of the pin block support. This results in a more compact and efficient assembly, reducing the risk of interference with other components and enhancing the overall reliability and performance of the modular connector system.

[0015] When the pins with the splice element are stitched into the pin block module, the pins may comprise retention barbs at the center of the pins, to anchor the pins within the pin block support. Such barbs have a direction of insertion and are secured within the pin block support in the direction opposite to the direction of insertion. The splice element comprises a splice portion attached to the end of the barbs in direction of insertion, thereby allowing a maximum length of the barbs to anchor within the pin block support upon stitching. This design ensures a secure anchoring of the pins, enhancing the stability and reliability of the modular connector assembly.

[0016] In some embodiments, the pins can be secured in the pin block support by overmolding. Advantageously, the pins include a retention contour at the center of the pins and wherein the splice element comprises at least two splice portions, forming said retention contour. This retention contour is a specific shape or feature on the pin that aids in securing the pin within the pin block support. In contrast to the retention barbs, the retention contour does not necessarily have a direction of insertion. Instead, in this embodiment, the splice element is a component which comprises at least two splice portions, which are individual segments of the splice element that form the retention contour. They can have an irregular, rough, uneven, not level, embossed surface to enhance the mechanical grip or connection between the overmolded pin block support material and the pins. The splice portions can define a through hole, through which melted material for the pin block support can pass during molding, thereby holding the pins within the pin block support upon molding.

[0017] Another option to integrate a splice element into a pin block module is to arrange a splice inside of the pin block support, i.e. a splice element is present in the pin block support before mounting the at least two pins onto the pin block support. In such an option, the at least one splice element is distinct from the pins and is positioned

within the pin block support prior to the installation of the pins onto the pin block support. This configuration allows for a more streamlined assembly process and offers a higher connection flexibility, as the splice element is pre-arranged within the pin block support, ensuring that the pins can be mounted without interference and as the splice element may have a relatively complex shape.

[0018] The separate splice element can advantageously be a conductive trace on a printed circuit board (PCB). This conductive trace on the PCB adds versatility by allowing for more complex and reliable electrical connections within the pin block module. The integration of the PCB within the pin block support enhances the module's functionality by providing a stable and organized platform for the conductive trace, ensuring precise and efficient signal transmission between components. This arrangement facilitates easier assembly and maintenance of the pin block module, as the conductive trace on the PCB can be designed to meet specific electrical requirements and configurations.

[0019] For example, the conductive trace(s) of the separate splice element may directly connect at least two non-adjacent pins without connecting the intermediate pin between the two non-adjacent pins. This is a feature which cannot be implemented when the splice element is integrally formed with the pins to be spliced. This feature therefore allows for a more efficient and targeted electrical connection within the pin block module, bypassing unnecessary intermediate connections.

[0020] In a further implementation, the PCB forms the center of the pin block support. The pin block support may further comprise an overmolded shell surrounding the PCB, ensuring it is well-integrated and protected by the overmolded shell. The overmolding process involves encasing the PCB with a protective shell, which can enhance the durability and reliability of the pin block module by providing additional mechanical support and environmental protection. Similarly, the PCB can be protected by top and bottom covers that are clipped to each other around the PCB and held together by form-fit. This new feature (shell or covers) brings several advantages, including improved structural integrity of the pin block module, enhanced protection of the PCB from external factors such as moisture, dust, and physical damage, electrical isolation, and potentially better thermal management due to the encapsulating material of the overmolded shell. By incorporating an overmolded shell, the design ensures that the PCB and the pins remain securely in place within the pin block support, reducing the risk of dislodgement or damage during handling and operation.

[0021] In a further implementation, the PCB comprises at least one sensor for monitoring the operation of the pin block module. This sensor can e.g., be a temperature sensor or a moisture sensor, which can monitor the sealing of a closed connector. The sensor's role is to provide real-time data on the operational conditions of the pin block module, thereby enhancing its functionality

and reliability. This allows for the detection of potential issues related to e.g., temperature fluctuations or moisture ingress, which could affect the performance and longevity of the module. By monitoring these parameters, the system can ensure optimal operating conditions and preemptively address any anomalies that may arise, thus improving the overall efficiency and durability of the pin block module.

[0022] For the embodiments where the splice element is arranged inside the pin block support, the pins may have an oval slit, like an eye-shaped or cat-eyed shaped slit, in the center of the pin. This design feature allows the two sides of the slit, which are bowed towards the outside, to be elastically compressible. This elastic compressibility ensures that when the pin is mounted in the pin block support, it maintains reliable contact with the splice element. The oval slit in the pins enhances the functionality of the pin block module by providing a secure and consistent connection with the splice element. This design ensures that the pins can adapt to slight variations in positioning or pressure, maintaining a stable electrical connection within the pin block support.

[0023] It is possible to include spliced pins and unspliced pins within one pin block module, i.e. to combine spliced and unspliced pins within a single module, which can enhance the flexibility and efficiency of modular connectors by reducing the need for separate connectors and additional wire lengths. To this end, the pin block module includes at least three pins. Among these pins, at least two are spliced, meaning they are joined together, while at least one pin remains unspliced.

[0024] It is further possible to combine pins with integrally formed splice elements on one side of the pin block module with splice elements arranged within the pin block support and corresponding pins, for example to combine the benefits of a highly automatable overmoulding process and a highly specific process of stitching.

[0025] Some embodiments of the pin block module can be produced by stitching pins into the pin block support. For such a method, the pin block support comprises pin holes according to a desired pattern. Pins can be stitched into pin block supports according to a first embodiment having integrally formed splice elements and pins, and pins can be stitched into pin block supports according to a third embodiment having the splice element arranged inside the pin block support. The pins can be securely placed into the pin block support in a specific arrangement, which is crucial for the proper functioning of the modular connectors. The advantage of this method is that it allows for precise and reliable placement of pins.

[0026] Some embodiments of the pin block module can also be produced by arranging pins with at least one splice element according to a desired pattern and molding at least part of the pin block support around the pins and the at least one splice element.

[0027] Another method for producing a pin block module for use in modular connectors involves arranging at least two pins with the at least one splice element in a

specific desired pattern and subsequently molding at least part of the pin block support around these arranged pins and the at least one splice element. This method is used in replacement of the stitching method for the second embodiment of the pin block module and in addition to the stitching method for the third embodiment of the pin block.

[0028] The advantage of this method lies in its ability to integrate the pins and splice elements into a single molded structure, which can enhance the mechanical stability and reliability of the connector. By arranging the pins in a desired pattern and molding the support block around them, the method allows for precise control over the configuration and alignment of the pins, which is crucial for ensuring proper electrical connections. This approach may also facilitate the use of automated assembly techniques, enhancing manufacturing efficiency.

[0029] The pin block module of the invention can be part of a modular connector. Such a modular connector can include a connector housing with at least one pin block module seat. The pin block module can be mounted into this at least one seat.

[0030] The term "modular connector" refers to a connector system that is composed of interchangeable parts or modules, allowing for flexibility in configuration and application. The "connector housing" is the outer shell or casing that receives and holds several pin block modules. "The "seats" in the connector housing are designed to securely hold the pin block modules in place.

[0031] The advantage of this modular connector system is its flexibility and adaptability. By allowing different pin block modules to be mounted within the (same) connector housing, the system can be customized for various applications and requirements. This modularity can lead to cost savings, as it reduces the need for multiple distinct connector designs. It also simplifies maintenance and upgrades, as individual modules can be replaced or upgraded without needing to replace the entire connector system. Additionally, the modular design can improve the efficiency of manufacturing and assembly processes by standardizing components across different connector configurations.

4. Short description of the drawings

[0032] In the following, preferred embodiments of the disclosure are disclosed by reference to the accompanying figures, in which:

Fig. 1 shows different types of pins arranged to be accommodated in a pin block support;

Fig. 2 shows an embodiment of a pin block module with pins inserted into a pin block support;

Fig. 3 shows a schematic functioning of the integrated splice compared to the prior art;

- Fig. 4 shows an embodiment of a pin block module according to a first embodiment;
- Fig. 5 shows an embodiment of a pin block module according to a second embodiment;
- Fig. 6 shows an embodiment of a pin block module according to a third embodiment, showing separate splice elements;
- Fig. 7 shows the embodiment of a pin block module according to a third embodiment as shown in Fig. 6, with the outer protective shell;
- Fig. 8 shows an illustrative diagram of a network of the prior art;
- Fig. 9 shows an illustrative diagram of an exemplary network according to the invention.

5. Detailed description of preferred embodiments

[0033] In the following, preferred embodiments of the present disclosure are described in detail with respect to the figures.

[0034] Fig. 1 illustrates a plurality of pins 3. The plurality of pins 3 comprises an arrangement of four first pins 31 and four second pins 32 to be installed within a pin block support 2 (shown in Fig. 2). The first and second pins are spliced by means of splice elements 4, which will be described later in more detail. In addition, eighteen third pins 33 are arranged between the first and second pins. The third pins 33 are regular pins and not spliced. The pins 3 are arranged according to a desired pattern.

[0035] Retention barbs 311 are provided on the first pins 31, which facilitate anchoring within the pin block support 2. The retention barbs 311 are shaped to allow a direction of insertion 312 when stitching the first pins 31 into the pin block support 2. A splice element 4 in form of a splice portion 41 is integrally formed between the retention barbs 311 of two adjacent pins 31. The splice portions 41 are arranged at the ends of the respective retention barbs 311 when seen in the direction of insertion 312. Production tabs 42 are also present on these first pins 31 at the beginning of the retention barbs 311 when seen in the direction of insertion 312. These production tabs 42, however, are intended to be removed prior to the stitching of the first pins 31 into the pin block support 2. In the arrangement of the first pins 31, four pins are connected by three splice portions 41.

[0036] The second pins 32 are spliced by means of a splice element 4 that is formed by upper and lower splice portions 41 arranged in the center of the second pins 32. The splice element also forms a retention contour 321 of adjacent second pins 32. Together, the splice portions 41 define a through hole 413, designed to improve the retention of the second pins 32 upon e.g., molding the pin block support 2 onto (around) the pins. Also, in the

shown arrangement of the second pins 32, four pins 32 are spliced (i.e., connected with each other) in a rectangular configuration.

[0037] Fig. 2 provides a detailed view of a pin block module 1, comprising a pin block support 2 and the plurality of pins 3 of Fig. 1 arranged therein. On the left side, the pin block support 2 is overmolded onto the second pins 32. On the right side, the first pins 31 and third pins 33 are stitched into the pin block support 2 (obviously, the stitching is done after the support is molded onto the second pins). The pin block support 2 is shown as a solid structure, with pins extending from both the top surface 24 and the bottom surface (not visible in Fig 2). The top surface is in the following denoted as first connection surface 24 and the bottom surface is denoted as the opposing second connection surface 25. Arrows indicate a possible direction of electricity/signal flow 6 (input/output) of the pins 3. As the second pins 32 are spliced in a rectangular configuration, a single signal input into one pin is split into four signal outputs. Thus, the other three pin ends protruding from the first connection surface 24 of four spliced pins 32 are essentially without function and could be cut off. However, it is more cost efficient to simply leave the same. Similarly, the four first pins 31 are being spliced amongst them. Thus, a signal flow 6 input introduced into one pin leads to four signal flow 6 outputs, as indicated by the arrows. With the regular, un-spliced pins 33, each signal flow 6 input results in a single signal flow 6 output of the same pin.

[0038] Fig. 3 illustrates schematically the flow of electricity through a pin block support 2, 2' and a splice element 4, 4', comparing prior art on the left with the invention on the right. In the left diagram, the electricity (signal) flow 6 is depicted as first passing through a pin block support 2' and after that through a separate splice element 4' not part of the pin block support 2'. The right diagram shows a pin block module 1 according to the invention, with the pin block support 2 and the splice element 4 both being part of the pin block module 1.

[0039] Fig. 4 shows an embodiment of another pin block module 11 comprising a plurality (one row of 13 pins in total) of pins 3. The pin block module 11 comprises a pin block support 21, which has a first connection surface 24 and an opposing second connection surface 25. Pin block module 11 includes four spliced pins 31, which extend through the pin block support 21. Thus, one signal introduced to one of the four spliced pins is split into four signals. Each pin 31 protrudes from both the first connection surface 24 and the second connection surface 25. The pins 31 are stitched into the pin block support 21 in the direction indicated by arrow 312. The pins 31 include retention barbs 311 at their center, which anchor the pins 31 within the pin block support 21. The module further comprises a splice element 4 with splice portions 41, which connects the four pins 31 with each other. The splice element 4 is arranged completely inside the pin block support 21 and is integrally formed with the pins 31.

Generally, the splice element 4 is formed such that the pins 31 can be stitched into the pin block support 21 without the splice element 4 protruding from the pin block support 21. The splice portions 41 are arranged at the end of the barbs 311 when seen in the direction of insertion 312, allowing the length of the barbs 311 to anchor within the pin block support 21 upon stitching. In the module 11 of Fig. 4, also nine regular pins 33 are visible, that are not spliced.

[0040] Fig. 5 illustrates another embodiment of a pin block module 12, similar to the module 11 of Fig. 4. This pin block module 12 comprises a pin block support 22, which holds in total thirteen pins 3, of which four pins 32 are spliced with each other, and nine pins 33 are not spliced. The pin block module 22 is overmolded over all of the pins 3. The module 12 includes a splice element 4, which connects the spliced pins 32 to each other. The splice element 4 is arranged inside the pin block support 22 and comprises splice portions 41 that define a through hole 413. The through hole 413 increases the retention force of the spliced pins 32 upon molding. The splice element 4 is integrally formed with the spliced pins 32.

[0041] Fig. 6 shows a printed circuit board (PCB) 231, that can be arranged inside a pin block support 23 (shown in Fig. 7). A plurality of pins 3 (26 in total) is stitched through the PCB 231. The pins 3 may be regular pins 33 as the ones exemplarily shown in Fig. 1. The PCB 231 features conductive traces 432 that serve as a splice element 4 to electrically connect (splice) pins 3. In the shown example, the traces 432 connect three pins 3 in a triangular configuration.

[0042] Fig. 7 illustrates a pin block module 13 comprising a pin block support 23 that encapsulates the PCB 231 of Fig. 6. To this end, the pin block support 23 comprises an overmolded shell 235 surrounding the PCB 231. The overmolded shell 235 forms the exterior of the pin block support 23, providing structural integrity and protection to the internal components. The pins 3 protrude through the overmolded shell 235, allowing for external connections. The pin block module 13 also includes structural features such as mounting elements 236, which facilitate the installation of the module into a housing.

[0043] Fig. 8 shows a prior art configuration of a network with multiple splices 51. The network is composed of nodes interconnected by lines representing connections comprising one or more wires between the two endpoints, where each node represents a possible wire endpoint such as for example a connector, a splice, a splice saver or a ring terminal. The splices 51 are distributed throughout the network, indicating points where splicing occurs. The splices are positioned at various nodes, suggesting that splicing is required at multiple locations within the network. The figure illustrates a complex arrangement with several splices, which may imply potential inefficiencies or vulnerabilities and manufacturing hurdles in the network due to the numerous splicing points.

[0044] Fig. 9 illustrates the invention, which allows an

improved network configuration. In this figure, the network also consists of nodes interconnected by lines, similar to the prior art. However, the invention introduces an integrated splice saver 53, such as a pin block module 1 of the invention. This splice saver 53 is strategically placed within the network, reducing the number of splices 51 required. The figure shows that the integrated splice saver 53 consolidates multiple splicing points into a single location, thereby simplifying the network structure. The reduction in the number of splices 51 enhances the network's efficiency and reliability by minimizing the potential points of failure and maintenance requirements and facilitating manufacturing. This configuration demonstrates a significant improvement over the prior art by optimizing the splicing process and reducing the complexity of the network.

List of reference signs

[0045]

1, 11, 12, 13	pin block modules
2, 21, 22, 23	pin block support
2'	prior art pin block support
231	PCB
235	shell
236	latching means
24	first connection surface
25	second connection surface
3	pin[s]
31	first pin[s]
311	retention barb[s]
312	direction of insertion
32	second pin[s]
321	retention contour
33	third pin[s] / regular pins
4, 4'	splice element[s]
41	splice portion[s]
42	production tab[s]
432	conductive trace
51	splice
52	connector of the prior art
53	inliner with integrated splice saver
6	electricity/signal flow (input/output)

Claims

1. Pin block module (1, 11, 12, 13) for insertion into a housing of a modular connector, the pin block module (1, 11, 12, 13) comprising
 - a pin block support (2, 21, 22, 23) having a first connection surface (24) and an opposing second connection surface (25),
 - at least two pins (3, 31, 32, 33) extending through the pin block support (2, 21, 22, 23) such that each pin (3, 31, 32, 33) protrudes from the first connection surface (24) and from the

- second connection surface (25), **characterized in that** the pin block module (1, 11, 12, 13) further comprises
- at least one splice element (4) connecting the at least two pins (3, 31, 32, 33) to each other to splice them.
2. Pin block module (1, 11, 12, 13) according to claim 1, wherein the at least one splice element (4) is arranged inside the pin block support (2, 21, 22, 23).
 3. Pin block module (1, 11, 12) according to claim 1 or 2, wherein the at least two pins (3, 31, 32) and the splice element (4) are integrally formed.
 4. Pin block module (1, 11, 13) according to any one of the preceding claims, wherein the splice element (4) is formed such that the at least two pins (3, 31, 33) can be stitched into the pin block support (2, 21, 23).
 5. Pin block module (1, 11) according to any one of the preceding claims, wherein the pins comprise retention barbs (311) at the center of the pins (3, 31), to anchor the pins (3, 31) withing the pin block support (2, 21).
 6. Pin block module (1, 12) according to any one of the preceding claims, wherein the pins (3, 32) include a retention contour (321) at the center of the pins (3, 32) and wherein the splice element (4) comprises at least two splice portions (41), the splice portions (41) defining a through hole (413).
 7. Pin block module (1, 13) according to anyone of the preceding claims, wherein at least one splice element (4) is a splice element (432) separate from the pins (3, 33) and arranged inside the pin block support (2, 23).
 8. Pin block module (1, 13) according to claim 7, wherein the separate splice element (432) comprises a conductive trace (432) which is part of a printed circuit board, PCB (231), arranged inside the pin block support (2, 23).
 9. Pin block module (1, 13) according to claim 8, wherein the conductive trace (432) of the separate splice element (432) directly connects at least two non-adjacent pins (3, 33) without connecting the intermediate pin(s) (3, 33) between the two non-adjacent pins (3, 33).
 10. Pin block module (1, 13) according to claim 8 or 9, wherein the PCB (231) forms the center of the pin block support (2, 23) and wherein the pin block support (2, 23) further comprises an overmolded shell (235), or top and bottom covers held together by form-fit, and a surrounding the PCB (231).
 11. Pin block module (1, 13) according to any one of claims 8 to 10, wherein the PCB (231) comprises at least one sensor for monitoring the operation of the pin block module (1, 13), such as a temperature sensor.
 12. Pin block module (1, 11, 12, 13) according to any preceding claim, wherein the pin block comprises at least three pins (3, 31, 32, 33), wherein at least two pins (3, 31, 32, 33) are spliced and wherein at least one pin is not spliced.
 13. Modular connector, comprising a connector housing with at least one pin block module (1, 11, 12, 13) seat, and at least one pin block module (1, 11, 12, 13) according to any one of the preceding claims 1 to 12 mounted in the at least one seat.
 14. Method of producing a pin block according to any claim 1 to 5, 7 to 12, the method including
 - providing a pin block support (2, 21, 23) with pin holes (211) according to a desired pattern;
 - stitching at least two pins (3, 31, 33) into the pin block support (2, 21, 23).
 15. Method of producing a pin block according to any claim 1 to 3, 6 to 12, the method including
 - arranging at least two pins (3, 32, 33) according to a desired pattern;
 - molding at least part of the pin support block around the at least two pins (3, 32, 33) and the at least one splice element (4).

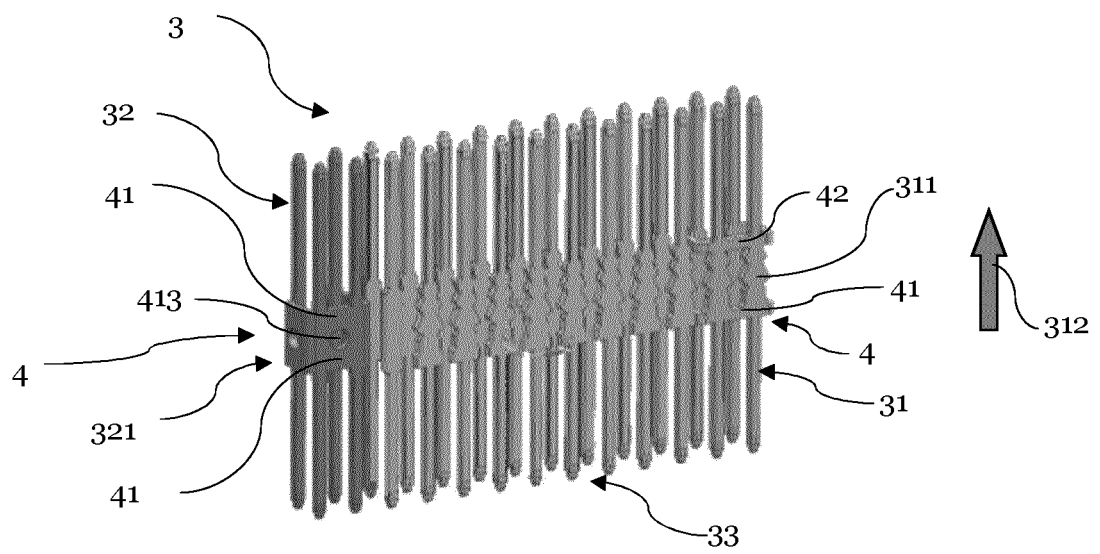


Fig. 1

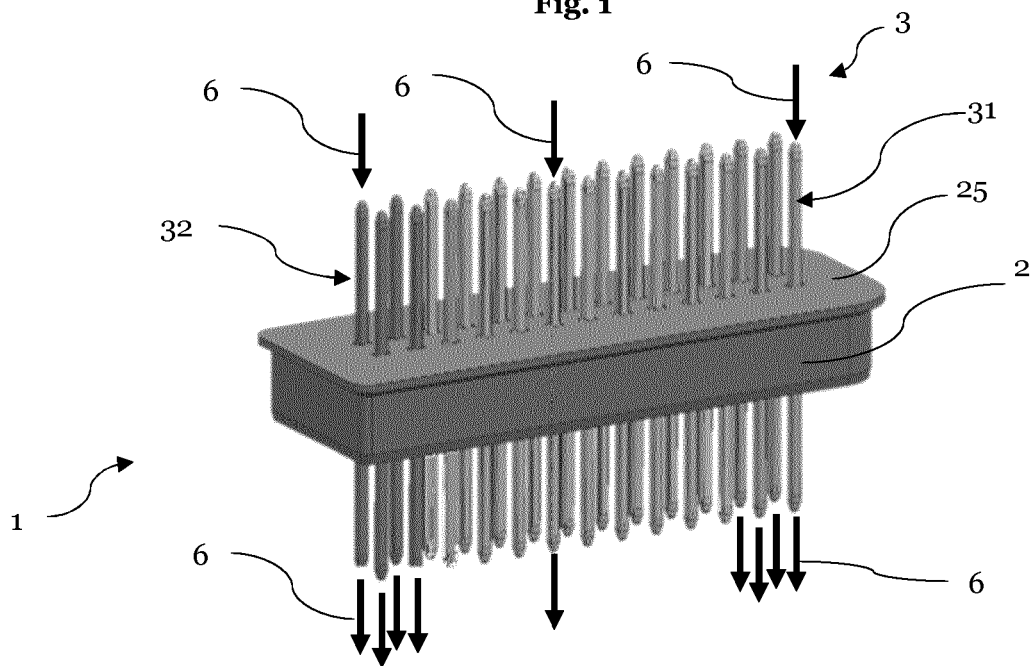


Fig. 2

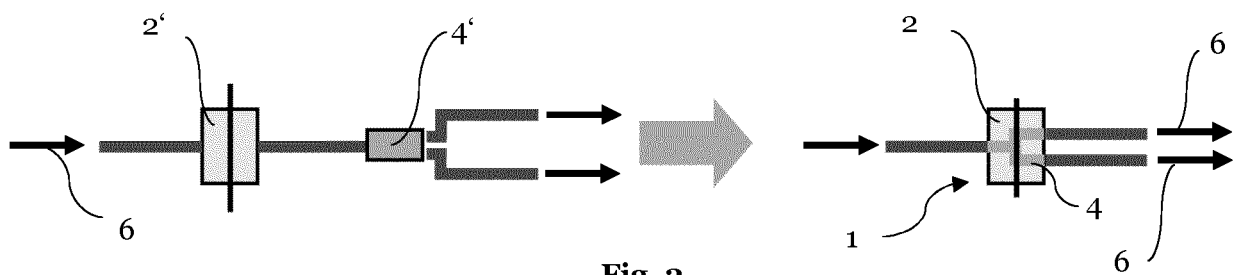


Fig. 3

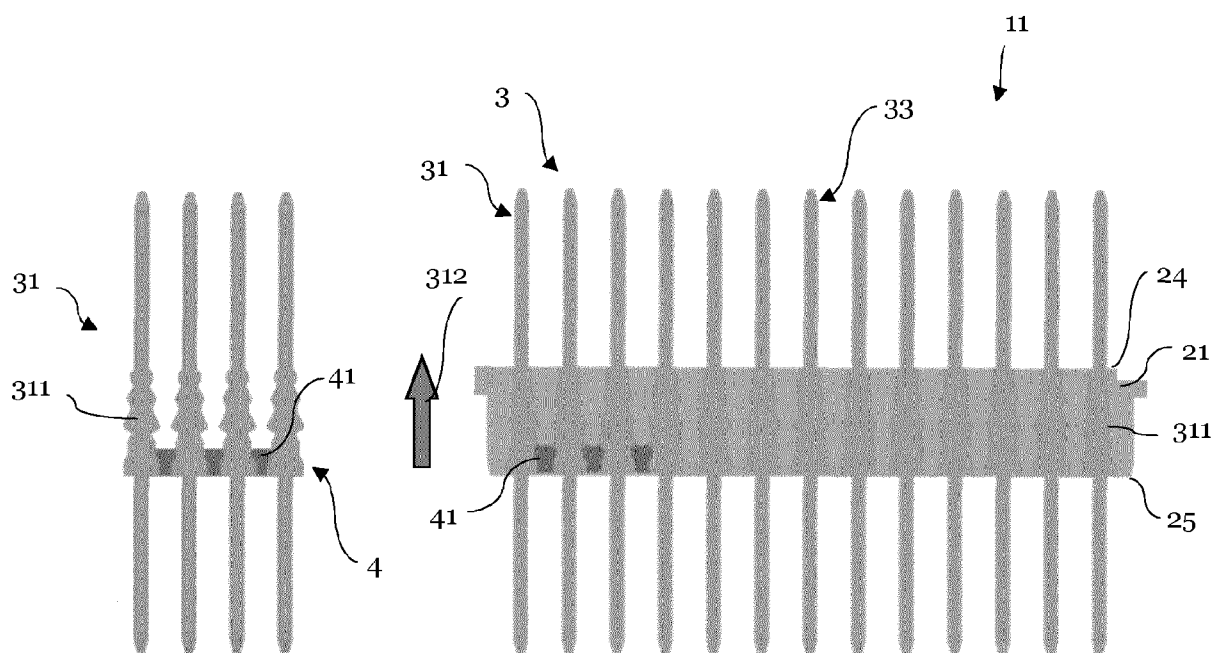


Fig. 4

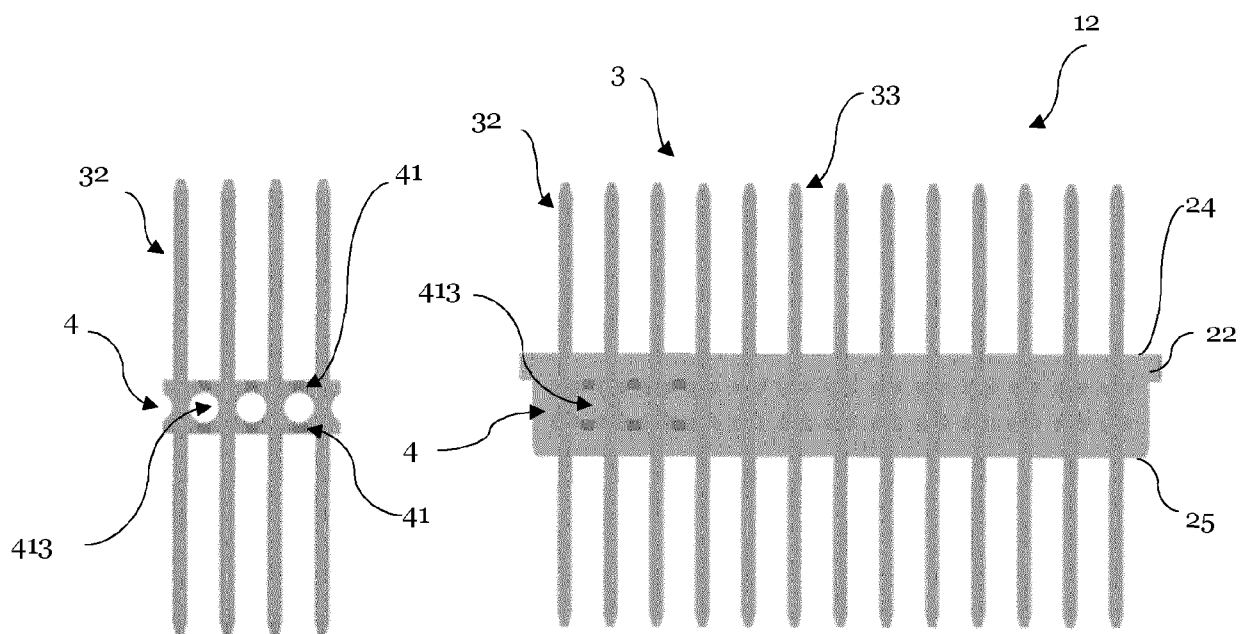


Fig. 5

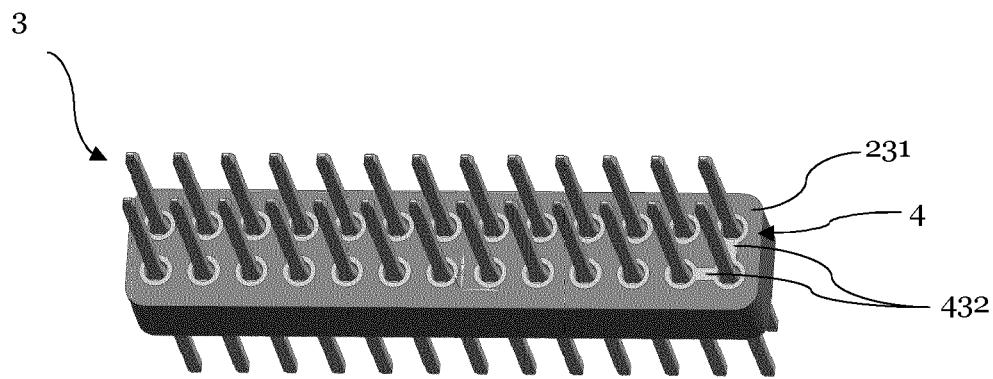


Fig. 6

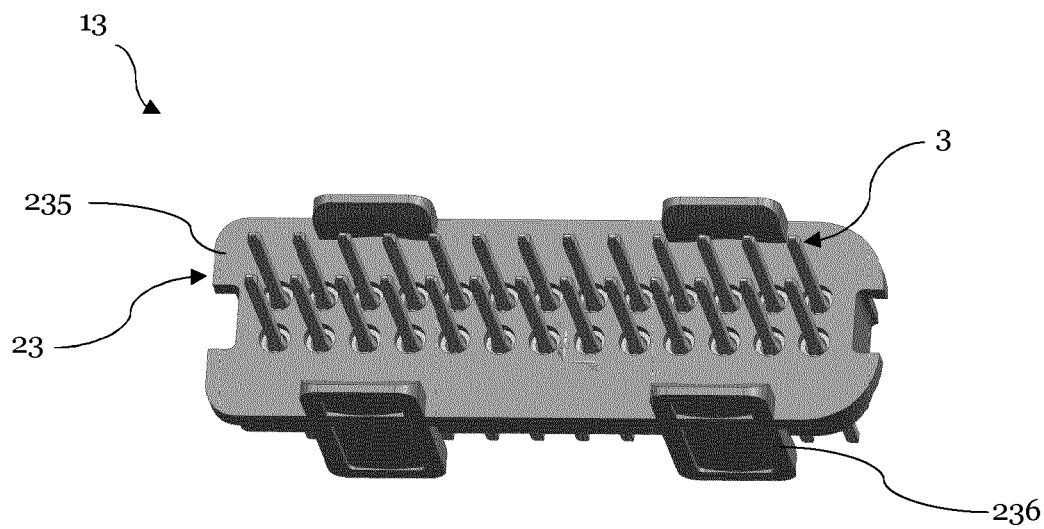


Fig. 7

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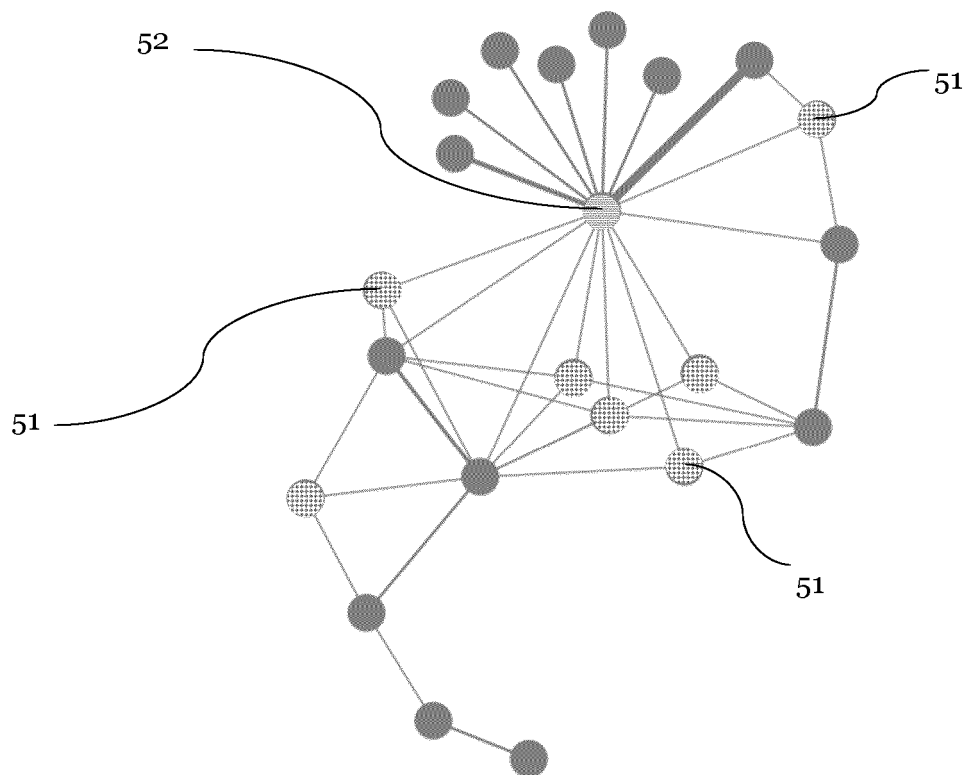


Fig. 8

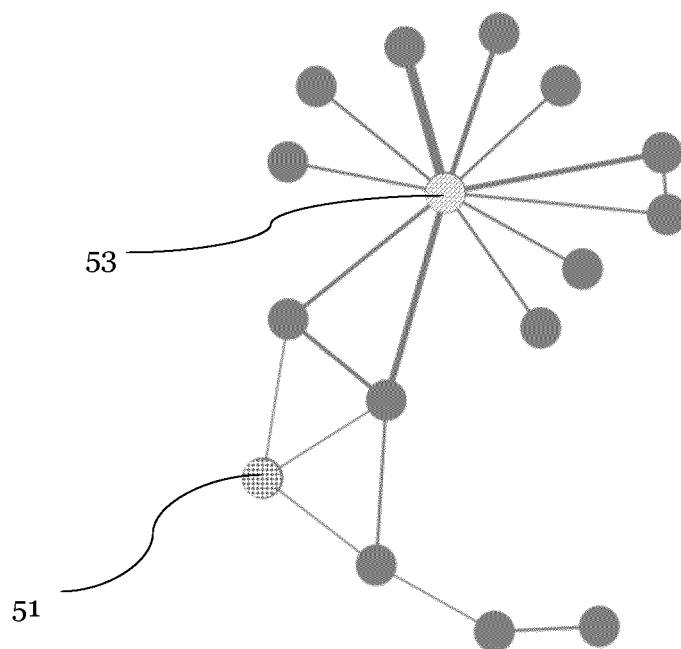


Fig. 9



EUROPEAN SEARCH REPORT

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