# PRINTED CIRCUIT BOARD FOR CONNECTING BATTERY CELLS AND BATTERY

The present invention concerns a board for connecting battery cells, which is formed in part from an electrically non-conductive material, wherein the board has on a first side and on a second side in each case at least one electrically and thermally conductive contacting section, and wherein each contacting section is electrically and thermally conductively connected to each other contacting section.

From the state of the art it is known that battery cells within a battery can be electrically and thermally connected to each other via a board. This allows an electric current and a heat flow to be distributed as evenly as possible within a battery by means of such a board. In particular, this prevents local thermal hot spots from forming in the battery, which is particularly detrimental to battery operation. It is desirable that the operating temperature of the battery is kept as low as possible. The present invention is therefore based on the object of providing a board that is suitable not only for distributing a heat flow within a battery, but also for dissipating the heat flow from the battery.

The object is solved by a board of the aforementioned type, which in accordance with the invention is configured in that a core made of a preferably electrically conductive and thermally conductive material is arranged in the electrically non-conductive material of the board, wherein the at least one contacting section is arranged in each case on the sides of the electrically non-conductive material facing away from the core, and wherein at least one electrically and thermally conductive lead-through element extends through the core and through the electrically non-conductive material arranged on both sides of the core, and wherein the lead-through element is electrically insulated from the core and is electrically conductively connected to the at least one contacting section on the first side and to the at least one contacting section on the second side, such that an electrically and thermally conductive connection of the contacting sections on the first side to the contacting sections on the second side is

made by the lead-through element and a heat flow can be picked up through the core and dissipated from the board.

The core is made of a material being both electrically and thermally conductive. Electrically conductive materials often offer the advantage that they are also thermally highly conductive. The core is arranged in the electrically non-conductive material of the board. The core is preferably configured planar. For example, the core can be a plate made of an electrically and thermally conductive material on which the electrically non-conductive material is arranged on both sides. The electrically non-conductive material is preferably applied to the core in a planar manner. However, the core does not necessarily have to be planar. Thus, according to the invention, it is also possible that the core is made of individual conductive elements or a texture of ladder elements. Deviating geometric shapes of the core are also possible according to the invention.

At least one electrically and thermally conductive lead-through element is passed through the electrically non-conductive material and the core. It electrically conductively connects the at least one contacting section on the first side of the board to the at least one contacting section on the second side of the board. It can connect the two contacting sections either directly or indirectly, for example via further electrically and thermally conductive elements. The lead-through element is electrically insulated from the core. This is necessary so that an electric current from the lead-through element cannot pass from the board via the core. This is usually undesirable, as an electric current is to be distributed through the board over several battery cells, but not from the board to other elements such as a heat sink connected to the core. As it is much more elaborate to electrically insulate the heat sink from other components, the core is already electrically insulated from an electrical current conducted through the connecting elements according to the invention. The electrical insulation can be achieved by an electrically non-conductive material surrounding the lead-through element in the core. The electrically non-conductive material surrounding the lead-through element is preferably in a thermally conductive

connection with both the core and the lead-through element. Thus a heat flow can be led from the at least one lead-through element to the core.

According to the invention, the electrically non-conductive material can be made of a common substrate material that is used for boards or circuit boards. The electrically and thermally conductive contacting sections as well as the electrically and thermally conductive lead-through elements are preferably made of a metal. Copper is particularly preferred. This is advantageous because copper has particularly good electrical and thermal conductivity. The board can be produced at a reasonable price using production methods known to the person skilled in the art in the field.

According to a possible configuration of the invention, the contacting sections and other electrically and thermally conductive elements are arranged on the first side and on the second side of the board in mirror image in respect to each other. According to an alternative configuration of the invention, however, the layout on the first side and on the second side of the board is different.

Preferably the core is at least in sections led out of an edge of the board or is exposed on this edge. The core is therefore suitable for conducting thermal energy out of the side of the board. The core can be led out of the board or can be exposed at several edges. Preferably, the core is guided completely out of one edge of the board in the circumferential direction or is completely exposed on this edge in the circumferential direction. According to the invention, it is also possible that the core is not exposed at an edge of the board or led out of it, but is led out of the board through a recess in the non-conductive material of the board. It should be ensured that the core in this area has a sufficiently large cross-section to provide for a sufficiently large heat flow being led out of the board.

According to a particular embodiment of the invention, the core is thermally conductively connected to a thermally conductive heat dissipating element or the core forms a thermally conductive heat dissipating element, wherein the heat dissipating element has a first planar section extending in a plane of the board, and wherein the

heat dissipating element has a second planar section extending in another plane oriented at a right angle to the plane of the board. Such a heat dissipation element is particularly suitable for dissipating a heat flow from a battery. The first planar section is suitable for leading a heat flow out of a cell arrangement of a battery in which the board is arranged. The second planar section of the heat dissipation element is suitable for dissipating this heat flow to a heat sink. For this purpose, the second planar section can lie flat against a heat sink. This heat sink can be a housing which is disposed around a cell arrangement in which the board is arranged. However, the heat sink can be another cooling element. Since the second planar section of the heat dissipation element is planar, a particularly large heat flow can be dissipated via the second planar section to a heat sink.

According to the invention, the core inside the board can be made of a metal. Most metals not only have very good electrical conductivity, but also very good thermal conductivity. According to the invention, the core can be made of copper. Alternatively, the core can also be made of another metal or a metal alloy.

The core is particularly preferably made of aluminum. Aluminum has very good thermal conductivity, but also low density. This allows the board to be made particularly light, which can have a significant effect on the weight of a battery, which contains a plurality of boards that are configured according to the invention.

The board may be configured in accordance with the invention such that an electrically and thermally conductive connecting section is arranged on the first side of the board, which electrically and thermally conductively connects the contacting sections to one another on the first side of the board, and wherein an electrical fuse is assigned to each of the contacting sections on the first side of the board and the connecting section on the first side of the board is connected to each contacting section on the first side of the board via an electrical fuse assigned to this contacting section, such that the contacting sections on the first side of the board are electrically secured with respect to the connecting section. This is in particular advantageous if an internal resistance of a battery cell to which the board is connected breaks down due

to a fault in the battery cell, so that a exceedingly high current is conducted through this battery cell. In this case, an electrical fuse is triggered which is assigned to a contacting section of the board which is electrically and thermally conductively connected to the defective battery cell. An excessive current therefore cannot flow from the defective battery cell into the connection section. As a result, further battery cells which are electrically and thermally conductive abutting at further contacting sections of the board are electrically protected against the defective battery cell.

It is particularly preferred that the lead-through elements are arranged such that they electrically and thermally conductively connect the connecting section on the first side of the board to the at least one contacting section on the second side of the board, such that each contacting section on the first side is secured against each other contacting section on the first side of the board and against each contacting section on the second side of the board by at least one electrical fuse. This ensures that all contact sections are electrically secured against each other. Such an arrangement can avoid the need to provide an unnecessarily large number of fuses. In particular, the arrangement according to the invention does not require that conductive lead-through elements, which connect the contacting sections of the first side and the second side of the board with each other, must be dimensioned as fuses. However, it is also possible to use alternative configurations of the invention, according to which lead-through elements are dimensioned as fuses. According to the invention, it is particularly possible that lead-through elements are not arranged in a connecting section, but each directly connect contacting sections on the first side and on the second side of the board to each other.

It is advantageous if the connecting section is formed as a planar, electrically and thermally conductive layer on the first side of the board. If the connection section is formed as a planar layer, then it has a very high electrical and thermal conductivity and is therefore particularly suitable for distributing an electrical and a thermal current between the contacting sections on the first side of the board. Alternatively, the connecting section can be designed as a composite of conductor tracks which are electrically and thermally conductively connected to one other. The advantage of a

composite of conductor tracks is that less electrically and thermally conductive material has to be used for the connecting section. Additional space remains on the board for other components that can be arranged on the non-conductive material.

Preferably the at least one contacting section is arranged on the second side of the board in a planar, electrically and thermally conductive connecting and contacting region on the second side of the board. If the connection and contacting region on the second side of the board is formed as a planar layer, it has a very high electrical and thermal conductivity and is therefore particularly suitable for distributing an electrical and thermal current between the contacting sections on the second side of the board. However, the connection and contacting region can also be configured differently. Thus, configurations are also possible in which the second side has a connecting section and contacting sections which is arranged in a mirror image to the connecting section and the contacting sections on the first side of the board. According to the invention, a fuse can also be assigned to each contacting section on the second side of the board. However, fuses on the at least one contacting section on the second side of the board are not absolutely necessary, as it has turned out that in the event of a defect, the fuses arranged on the first side of the board are sufficient to adequately protect battery cells electrically and thermally connected to the board. For this reason, a configuration of the invention with a planar connection and contacting region is preferred, in which contacting sections are not separated from the connection and contacting region in a particular manner.

According to a particular configuration of the invention, the connection section on the first side is connected to the connection and contacting region on the second side through the electrically non-conductive material, preferably electrically and thermally conductively. Thus it is not necessary that the connecting section on the first side of the board is directly connected to a contacting region on the second side in an electrically and thermally conductive manner via a contacting element. Instead, there may be an electrically and thermally conductive connection between the connection section on the first side and the connection and contacting region on the second side.

An electrical and a thermal current can be conducted to the connection and contacting region to at least one contacting section on the second side of the board.

According to a further configuration of the invention, around each contacting section on the first side of the board, a plurality of lead-through elements are arranged uniformly spaced apart from the contacting section. It has been shown that by providing several lead-through elements, an electrical and thermal current can be conducted particularly well from the first side of the board to the second side of the board. It has been found to be advantageous if the lead-through elements are arranged near the contacting sections in the connecting section on the first side of the board. A circular arrangement of the lead-through elements around the contacting sections is particularly suitable. A number of six to twelve lead-through elements has been found to be particularly advantageous.

According to the invention, at least one lead-through element can be arranged on an inner edge of a lead-through recess through which passes through the non-conductive material. The recess may be circular or of any other shape. The lead-through element is preferably a metal layer which, according to the invention, can be evaporated or printed onto the inner edge of the lead-through recess. The lead-through recess can be drilled or punched into the non-conductive material. However, the lead-through element may also be configured differently and, in particular, may not necessarily be arranged along a lead-through recess through the non-conductive material. For example, the lead-through element can be inserted into the non-conductive material as a rivet element in accordance with a possible configuration.

According to the invention, the contacting sections can be elevated on the first side and/or on the second side of the board with respect to a plane defined by a surface of the first side or the second side of the board, respectively. An elevated element of the contacting section preferably has a flat surface or a surface with a relief shape adapted to a shape of an end terminal of a battery cell. This improves contacting of the contacting section with a battery cell. The contacting section is preferably configured

in such a way that it protrudes between 0.1 mm and 0.3 mm from the plane defined by the surface of the first side or the surface of the second side of the board, respectively.

It is advantageous if the contacting sections have elevated contacting points. The contact points can be used to establish a well-defined electrically and thermally conductive connection between the contact sections and adjacent battery cells.

Preferably the board is flexible. For this purpose, the board can be made of flexible and/or elastic materials. For example, the electrically non-conductive material may be made of an elastic polymer. The electrically non-conductive material can be formed from a polyimide, which is preferably Kapton. Kapton is chemically highly resistant and has very high breakdown field strength. The electrically and thermally conductive material applied to the board, of which the contacting sections, the connecting section on the first side of the board, the connection and contacting region on the second side of the board and the at least one lead-through element consist of, is advantageously metal. Suitable metals have sufficient elasticity or flexibility so that the electrically conductive sections of the board are not damaged by any possible deformation of the board. The amount of metal applied is advantageously dimensioned such that it will not be damaged by the possible deformation of the board, which could cause sections of the board to diminish or lose their electrical and thermal conductivity.

Particularly preferably, at least one cooling line is provided in the board to cool the board. The cooling line can pass through the board in a plane formed by the board. According to the invention, several cooling lines can be provided in the board. The cooling line can pass through the core of the board according to the invention.

Preferably at least one additional contact is provided on the interconnection of conductor tracks or on the planar, electrically and thermally conductive layer on the first side of the board and/or on the connection and contacting region on the second side of the board. Such a contact is not intended to be contacted by a battery cell. A battery management system can be connected to such a contact so that, for example, a voltage applied to the board can be measured.

Preferably at least one further contact is provided on the board. The further contact can be connected, for example, to a measuring device which is mounted on the board or provided in the board. This may be a temperature sensor. In accordance with the invention, the contact can also be used to connect a bus system which can be used to read out and/or control measuring devices provided on the board.

The present invention further concerns a battery having a cell arrangement, wherein the cell arrangement comprises a plurality of battery cells, wherein the cell arrangement comprises at least two battery sections and each battery section consists of a plurality of battery cells, wherein the battery cells of the battery sections are aligned such that end terminals of the battery cells of the respective battery section are located in a common first contacting plane and that end terminals of the battery cells of the respective battery section are located in a common second contacting plane, wherein the battery sections are arranged adjacent to one another, wherein in each case a first contacting plane of a battery section faces a second contacting plane of an adjacently arranged battery section, and wherein the contacting planes are aligned parallel to one another, wherein an at least partially electrically and thermally conductive connecting plate having a first side and a second side is arranged between at least two successive battery sections, which has on the first side and on the second side in each case at least one thermally and electrically conductive contacting section, wherein the end terminals facing the first side of this connecting plate are thermally and electrically conductively connected to the at least one contacting section of this first side, and wherein the end terminals facing the second side of this connecting plate being thermally and electrically conductively connected to the at least one contacting section of this second side, and wherein contact sections of the connecting plate are electrically and thermally conductively connected to one another via the connecting plate. In accordance with the invention, the connecting plate is configured as a board as described above. The core is thermally conductively connectable to a heat sink such that a heat flow can be picked up through the core and dissipated from the cell arrangement onto the heat sink.

The battery contains several battery cells in each battery section. Preferably the battery cells are round cells. These have proven to be particularly resistant to mechanical stresses.

Preferably each battery cell has a positive and a negative end terminal and the battery cells of the battery sections are aligned such that all positive end terminals of the battery cells of the respective battery section lie in the first contacting plane and that all negative end terminals of the battery cells of the respective battery section lie in the second contacting plane, wherein the end terminals connected to the at least one contacting section of the first side are electrically and thermally conductively connected to each other via the connecting plate, the end terminals connected to the at least one contacting section of the second side being electrically and thermally conductively connected to one another via the connecting plate, and the end terminals connected to the at least one contacting section of the first side being electrically and thermally conductively connected to the end terminals connected to the at least one contacting section of the second side via the connecting plate, so that the battery cells are electrically conductively connected to one another in an electrical and thermal series and parallel circuit. The advantage of such an arrangement is that an electric current and a thermal current can be distributed over the entire cell arrangement. If a battery cell in a battery section fails, the performance of the battery is only slightly impaired because there are other functioning battery cells in the battery section. A positive end terminal or a negative end terminal is to be understood as a positive pole or a negative pole of a battery cell, respectively.

The cell arrangement can be enclosed by a thermally conductive housing in accordance with the invention. As the housing is thermally conductive, it is suitable for absorbing heat from the cell arrangement as a heat sink and optionally transferring it to other heat sinks to which it is thermally conductively connected. The previously described heat dissipation element can be thermally conductively connected to the housing. The housing is preferably made of a metal, preferably iron, aluminum or a metal alloy. Such a housing is suitable for protecting the cell arrangement from external influences. The housing preferably has two openings on

which the pressure plates are placed. The housing may comprise elongated recesses as ventilation slots according to the invention.

According to the invention, the battery cells can be arranged such that first end terminals of a contacting plane of a first battery section are arranged directly opposite to second end terminals of a contacting plane of a second battery section, so that all the battery cells of a battery section are arranged in alignment with the battery cells of an adjacent battery section. Thus, groups of battery cells of several battery sections are arranged in rows.

Preferably, positive end terminals of a battery section are directly electrically and thermally conductively abutting to negative end terminals of an adjacent battery section. Accordingly, two or more battery cells are connected in series without directly adjacent battery cells being separated from each other by a board. Such a structure can be provided if sufficient distribution of an electric current and a heat flow within a battery is possible even with a small number of boards within the cell array. Whether this is the case is largely determined by the capacitive and other properties of the battery cells.

It is preferred when a battery start region and a battery end region are defined by the end terminals located in the two outer contact planes of the battery, wherein a respective pressure plate is arranged at the battery start region and the battery end region, wherein the pressure plates are connected to one another via tension elements and thereby the battery cells abutting to the at least one board are pressed to the at least one board.

The components within the cell assembly are thereby pressed together. Herein, the pressure plates exert a contact force on the battery cells. According to the invention, the pressure plate may exert the contact pressure at the battery start section or on the battery end section directly on the battery cells. The pressure plate may abut directly to the end terminals of the battery cells. Alternatively, the pressure plate can exert the contact force at the battery start section or at the battery end section also indirectly

on the battery cells. Between the pressure plate and the battery cells, an additional layer may be provided according to the invention. This additional layer may be configured electrically non-conductively and/or elastically.

According to the invention, the pressure plates can be formed planar, but different configurations of pressure plates are also possible. The tension elements are each connected to the pressure plates. Advantageously, no electrical connection exists between the battery cells and the tension elements. Herein, the tension elements are clamped in such a way between the pressure plates that they exert a tensile force on the pressure plates. Due to the tensile force, the pressure plates can in turn exert the already described contact pressure on the cell arrangement. The contact force is transmitted across all battery sections of the cell assembly within the battery. As a result, the battery cells are particularly well contacted with the at least one contacting section element within the cell assembly.

The tension elements can be in the form of rods, tubes or other elongated elements. Preferably the rods are made of a metal, most preferably made of steel. Especially if an electrically conductive material is used for the tension elements, advantageously there is no electrically conductive connection between the tension elements and the battery cells or other current-carrying components of the battery. Alternatively, the rods can also be made of a particularly stable plastic or composite material.

It is advantageous if the pressure plates are configured as metal plates. Metal plates are sufficiently stable so that a tensile force can be transmitted from the tension elements to the cell assembly. The metal plates can be made with different thicknesses depending on a desired tensile force. If a high tensile force is desired, the metal plate must be made particularly thick. Preferably, the metal plate is 3 to 20 mm in thickness, most preferably 5 mm in thickness. According to the invention, the metal plates can be formed of copper, aluminum or other very highly thermally conductive material. Alternatively, it is possible not to make the pressure plates of metal. Hence, the pressure plates may be made of a hard plastic according to the invention.

Preferably, the tension elements are passed through tension element recesses in the pressure plates, wherein the tension elements in the tension element recesses are bolted into the pressure plate and/or are bolted to the pressure plates by means of nuts. A threaded connection allows a precise adjustment of the tensile forces exerted by the tension elements on the pressure plates. However, according to the invention, other fixing means can also be used in order to fix the tension elements to the tension element recesses in such a way that the tension elements exert a tensile force on the pressure plates.

Further advantageous forms of implementation of the invention are shown in the drawings. Therein:

Fig. 1 shows a schematic representation of a board according to the invention in a view on a first side of the board,

Fig. 2 shows a schematic representation of the board according to Fig. 1 in a view on a second side of the board,

Fig. 3 shows a schematic representation of the board according to Fig. 1 and 2 with a lead-through recess in a sectional view,

Fig. 4 shows a schematic representation of a cell arrangement of a battery according to the invention with several boards,

Fig. 5 shows a schematic representation of a section of the cell arrangement of the battery according to Fig. 4 in a sectional view, and

Fig. 6 shows a schematic diagram of the battery according to Fig. 4 and Fig. 5 with a housing.

Fig. 1 shows a schematic representation of a board 1 according to the invention in a view on a first side 2 of the board. Here, the board 1 is part of a cell arrangement 3

with battery cells arranged offset in first cell planes 4 and in second cell planes 5 (not shown). Board 1 is suitable for cell arrangements 3 with seven first and second cell levels 4 and 5, with eight and seven battery cells being arranged in the first and second cell levels 4 and 5, respectively (not shown). Board 1 has tension element recesses 6 through which tension elements (not shown) can pass through.

Board 1 is partly made of an electrically non-conductive material. On the first side of the board 1, copper is applied as an electrically and thermally conductive material to the electrically non-conductive material. The copper material has several contacting sections 7. These are suitable for contacting the end terminals of battery cells. For this purpose, the contacting sections 7 are elevated. The contacting sections 7 are separated from a connecting section 9 by insulating sections 8 made of an electrically non-conductive material. The connecting section 9 is planar. It connects the contacting sections 7 with each other electrically and thermally conductively. An electrically and thermally conductive conductor track 10, which is dimensioned as a fuse, passes through each insulation section 8. Thereby, the contacting sections 7 are electrically secured against each other.

Around each insulation section 8 and thus also around each contacting section 7, several lead-through recesses 11 are arranged in a circular shape. In each lead-through recess 11, a lead-through element (not shown) is arranged which is arranged in the lead-through recess 11. The lead-through element is made of copper and connects the connecting section 9 of the first side 2 of board 1 with a second side (not shown) of board 1 electrically and thermally conductively. A current flowing from a battery cell into a contacting section 7 can thus be passed through the conductor track 10 and the connecting section to the second side of board 1. As the contacting sections 7 on the first side 2 of the board 1 are electrically secured with respect to the connecting section 9, they are also secured against contact sections (not shown) on the second side of board 1.

In board 1, a core 12 made of copper is arranged, which partially extends laterally into areas outside cell arrangement 3. In these areas outside the board 1, the core 12 forms

a heat dissipation element 13. Four heat dissipation elements 13 are shown here, each with a first planar section 14. At each heat dissipation element 13, there is also a second planar section, which is not visible due to the perspective shown.

Fig. 2 shows a schematic representation of board 1 according to Fig. 1 in a view on a second side 15 of board 1. On the second side 15 of board 1, there is a copper layer formed as a connecting and contacting region 16. In the connecting and contacting region 16, contacting sections 7 are arranged, which are suitable for contacting with end terminals of battery cells. Around each contacting section 7, several lead-through recesses 11 are arranged in a circular shape. Lead-through elements, which are not shown, are arranged in board 1 in the lead-through recesses 11 as described above.

The four heat dissipation elements 13, each with a first planar section 14, are also shown here. Also on the second side of board 1, the tension element recesses 6 are visible, through which tension elements (not shown) can be passed.

Fig. 3 shows a schematic view of board 1 according to Fig. 1 and 2 with a lead-through recess 11 in a sectional view. Board 1 comprises an electrically non-conductive substrate material 17. The substrate material 17 encloses the core 12. On the first side 2 of the board 1, a copper layer forms the connecting section 9. On the second side 15 of the board 1, a copper layer forms the connecting and contacting region 16. A lead-through recess 11 is passed through the board 1. It passes through the connecting section 9 and the connecting and contacting region 16. A lead-through element 18 made of copper is applied to the edge of the lead-through recess 11 as a thin layer. The lead-through element 18 is electrically isolated from the core 12 by the substrate material 17. However, a heat flow can flow through the substrate material 17 and be dissipated from board 1 via core 12.

Fig. 4 shows a schematic representation of a cell arrangement 3 of a battery 20 according to the invention with a board 1. In the cell arrangement 3, several battery cells 21 are arranged next to each other in a battery section 22. The battery cells 21 arranged in a battery section 22 are connected in parallel. A parallel connection of the

battery cells 21 is made possible by several boards 1 according to the invention. For this, the end terminals of the battery cells 21 are electrically and thermally conductively connected to the boards 1. The boards 1 are each arranged between two battery sections 22. Each battery section 22 has a height of seven battery cells 21. Battery cells 21 of adjacent battery sections 22 are connected in series by the boards 1 arranged between them. The battery cells 21 in cell arrangement 3 are thus connected to each other both in parallel and in series.

A battery start region 23 and a battery end region 24 are formed by positive end terminals and by negative end terminals of battery cells 21 in battery 20, respectively. Battery start region 23 and battery end region 24 are connected to outer boards 1. The outer boards 1 connect the end terminals of battery cells 21 electrically and thermally conductively. A pressure plate 25 is each arranged on the side of the outer boards 1 facing away from the battery start region 23 and the battery end region 24, respectively. The pressure plate 25 is made of copper. It therefore has particularly high heat conductivity.

The pressure plates 25 are connected to each other by tension elements 26 in an electrically isolated manner. The tension elements 26 are screwed to the pressure plates 25 in such a way that they exert a tensile force on the pressure plates 25. This compresses the cell arrangement 3. In particular, the battery cells 21 are pressed against the boards 1. This increases the contact area between the end terminals of the battery cells 21 and the boards 1, such that an electric and a thermal current can be distributed better between the battery cells 21 and the boards 1 and thus also distributed better over the entire cell arrangement 3. This avoids local thermal hotspots within the battery 20. Furthermore, due to the cell arrangement 3 pressed by the tension elements 26 and the pressure plates 25 in accordance with the invention, the battery 20 in accordance with the invention is particularly resistant to mechanical stresses.

In order to ensure that the battery cells 21 are securely held within the cell arrangement 3, the battery cells 21 are enclosed by several positioning plates 27. The

positioning plates 27 enclose the battery cells 21 in the battery sections 22 in a form-fitting manner. As a precise contacting of the end terminals of the battery cells 21 to the boards 1 is necessary, the positioning plates 27 are here arranged in the vicinity of the boards 1.

The boards 1 each have a core 12, which is laterally led out of the boards 1. Outside the boards 1, the core 12 forms a heat dissipation element 13. Heat can be dissipated from the cell arrangement 3 via the heat dissipation element 13. The heat dissipation element 13 has a first planar section 14 extending in a plane of the board 1 and a second planar section 28 extending in another plane oriented at a right angle to the plane of the board 1. The second planar section 28 is suitable for thermally conductive connection to a housing (not shown) or to a heat sink (not shown), such that a heat flow can be dissipated from board 1 to the housing or to the heat sink, respectively.

Fig. 5 shows a schematic representation of a section of the cell arrangement of the battery 20 according to Fig. 4 in a sectional view. The battery cells 21 are arranged in first cell levels 4 and second cell levels 5. The battery cells 21 are directly adjacent to each other. The second cell levels 5 each have one battery cell 21 less than the first cell levels 4. This results in outer passage sections 29. Tension elements 26 can be passed through the outer passage sections 29. The outer passage sections 29 allow as many battery cells 21 as possible to be arranged on the smallest possible cross-sectional area of a cell arrangement 3. For example, to insert a tension element 26 into the edge area of a battery section 22, it is not necessary to remove an entire battery cell 21. Instead, only a battery cell 21 is removed from a second cell level 5. The removal of one battery cell 21 from the second cell level 5 results in two outer passage sections 29. One or more tension elements 26 can be passed through each outer passage section 29. Here, one tension element 26 is passed through each outer passage section 29. In order to achieve uniform stabilization of the cell arrangement 3, however, an inner passage section 30 is also provided in which no battery cell 21 is arranged. A tension element 26 is passed through the inner passage section 30.

The battery cells 21 are enclosed in the battery section by the positioning plate 27. Tension element recesses 6 are provided in the positioning plate 27, through which the tension elements 26 are passed through into the outer passage sections 29 and into the inner passage section 30.

Fig. 6 shows a schematic representation of a battery 20 according to the invention with a housing 31. The housing 31 is made of iron and encloses a cell arrangement 3 according to the invention with boards 1. Inside the housing 31, heat dissipation elements 13 can be connected to the housing 31 such that a heat flow can be dissipated from the cell arrangement 3 to the housing 31. The housing 31 is firmly connected to a mounting plate 32, which serves as a heat sink. The housing 31 is closed at two ends by pressure plates 25. The pressure plates 25 have cooling fins 33, such the pressure plates 25 help to cool the cell arrangement 3 inside the housing 31. Tension elements, which are not shown, are passed through the pressure plates 25 and screwed to the pressure plates 25 by means of nuts 34 in an electrically insulated manner.

REFERERENCE NUMERALS

1. board
2 . first side of the board
3. cell arrangement
4. first cell level
5. second cell level
6. tension element recess
7. contacting section
8. insulation section
9. connecting section
10. conductor track
11. lead-through recess
12. core
13. heat dissipation element
14. first planar section of the heat dissipation element
15. second side of the board
16. connecting and contacting region
17. substrate material
18. lead-through element
20. battery
21. battery cell
22. battery section
23. battery start region
24. battery end region
25. pressure plate
26. tension element
27. positioning plate
28. second planar section of the heat dissipation element
29. outer passage section
30. inner passage section
31. housing

32. mounting plate
33. cooling fins
34. nut

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## Claims

1. Board (1) for connecting battery cells (21), which is formed in part from an electrically non-conductive material,
wherein the board (1) has on a first side (2) and on a second side (15) in each case at least one electrically and thermally conductive contacting section (7), and wherein each contacting section (7) is electrically and thermally conductively connected to each other contacting section (7),
**characterized in that**
a core (12) made of a preferably electrically conductive and thermally conductive material is arranged in the electrically non-conductive material of the board (1), wherein the at least one contacting section (7) is arranged in each case on the sides of the electrically non-conductive material facing away from the core (12), and
wherein at least one electrically and thermally conductive lead-through element (18) extends through the core (12) and through the electrically non-conductive material arranged on both sides of the core (12), and
wherein the lead-through element (18) is electrically insulated from the core (12) and is electrically conductively connected to the at least one contacting section (7) on the first side (2) and to the at least one contacting section (7) on the second side (15), such that an electrically and thermally conductive connection of the contacting sections (7) on the first side (2) to the contacting sections (7) on the second side (15) is made by the lead-through element (18) and a heat flow can be picked up through the core (12) and dissipated from the board (1).

2. Board (1) according to Claim 1,
**characterized in that**
the core (12) is at least in sections led out of an edge of the board (1) or is exposed on the edge.

3. Board (1) according to claim 2,
**characterized in that**
the core (12) is completely led out of an edge of the board (1) in the circumferential direction or is exposed on the edge.

4. Board (1) according to one of the preceding claims,
**characterized in that**
the core (12) can be thermally conductively connected to a thermally conductive heat dissipation element (13) or in that the core (12) forms a thermally conductive heat dissipation element (13),
wherein the heat dissipating element (13) has a first planar section (14) extending in a plane of the board (1), and
wherein the heat dissipating element (13) has a second planar section (28) extending in another plane oriented at a right angle to the plane of the board (1).

5. Board (1) according to one of the preceding claims,
**characterized in that**
the core (12) is made of a metal.

6. Board (1) according to claim 5,
**characterized in that**
the core (12) is made of aluminum.

7. Board (1) according to one of the preceding claims,
**characterized in that**
on the first side (2) of the board (1), an electrically and thermally conductive connecting section (9) is arranged, which electrically and thermally conductively connects the contacting sections (7) to one another on the first side of the board (1), and
wherein an electrical fuse is assigned to each of the contacting sections (7) on the first side (2) of the board (1) and the connecting section (9) on the first side (2) of the board (1) is connected to each contacting section (7) on the first side (2) of the board (1) via an electrical fuse assigned to this contacting section (7), such that the contacting sections (7) on the first side of the board (1) are electrically secured with respect to the connecting section (9).

8. Board (1) according to Claim 7,
**characterized in that**
the lead-through elements (18) are arranged such that they electrically and thermally conductively connect the connecting section (9) on the first side of the board (1) to the at least one contacting section (7) on the second side of the board (1), such that each contacting section (7) on the first side (2) is secured against each other contacting section (7) on the first side (2) of the board (1) and against each contacting section (7) on the second side (15) of the board (1) by at least one electrical fuse.

9. Board (1) according to claim 7 or claim 8,
**characterized in that**
the connecting section (9) is formed as an planar, electrically and thermally conductive layer on the first side (2) of the board (1).

10. Board (1) according to one of claims 7 or 8,
**characterized in that**
the connecting section (9) is formed as a composite of conductor tracks which are electrically and thermally conductively connected to one another.

11. Board (1) according to one of the claims 7 to 10,
**characterized in that**
the at least one contacting section (7) is arranged on the second side of the board (1) in an planar, electrically and thermally conductive connecting and contacting region (16) on the second side (15) of the board (1).

12. Board (1) according to Claim 11,
**characterized in that**
the connecting section (9) on the first side (2) is preferably electrically and thermally conductively connected to the connecting and contacting region on the second side (15) through the electrically non-conductive material.

13. Board (1) according to one of claims 7 to 12,
**characterized in that**
around each contacting section (7) on the first side (2) of the board (1), a plurality of lead-through elements (18) are arranged uniformly spaced apart from the contacting section (7).

14. Board (1) according to one of the preceding claims,
**characterized in that**
the at least one lead-through element (18) is arranged on an inner edge of a lead-through recess (11) which passes through the non-conductive material and the core (12).

15. Board (1) according to one of the preceding claims,
**characterized in that**
the contacting sections (7) on the first side (2) and/or on the second side (15) of the board (1) are elevated with respect to a plane defined by a surface of the first side or the second side of the board (1), respectively.

16. Board (1) according to one of the preceding claims,
**characterized in that**
the contacting sections (7) have elevated contacting points.

17. Battery (20) having a cell arrangement (3),
wherein the cell arrangement (3) comprises a plurality of battery cells (21),
wherein the cell arrangement (3) comprises at least two battery sections (22) and
each battery section (22) consists of a plurality of battery cells (21),
wherein the battery cells (21) of the battery sections (22) are aligned such that end terminals of the battery cells (21) of the respective battery section (22) are located in a common first contacting plane and that end terminals of the battery cells (21) of the respective battery section (22) are located in a common second contacting plane,
wherein the battery sections (22) are arranged adjacent to one another,
wherein in each case a first contacting plane of a battery section (22) faces a second contacting plane of an adjacently arranged battery section (22), and
wherein the contacting planes are aligned parallel to one another,
wherein an at least partially electrically and thermally conductive connecting plate having a first side (2) and a second side (15) is arranged between at least two successive battery sections (22), which has on the first side (2) and on the second side (15) in each case at least one thermally and electrically conductive contacting section (7),
wherein the end terminals facing the first side (2) of this connecting plate are thermally and electrically conductively connected to the at least one contacting section (7) of this first side (2), and

wherein the end terminals facing the second side (15) of this connecting plate being thermally and electrically conductively connected to the at least one contacting section (7) of this second side (15), and

wherein contact sections (7) of the connecting plate are electrically and thermally conductively connected to one another via the connecting plate,

**characterized in that**

the connecting plate is configured as a board (1) according to one of claims 1 to 16,

wherein the core (12) is thermally conductively connectable to a heat sink such that a heat flow can be picked up through the core (12) and dissipated from the cell arrangement (3) onto the heat sink.