

## Battery cell terminal alignment fixture

## TECHNICAL FIELD

- 5 The present invention relates to battery technology and more particularly to a battery cell terminal alignment fixture, a battery comprising such an alignment fixture and an electric water heating system comprising such an alignment fixture or battery.

## BACKGROUND

- 10 An increasing focus on using renewable energy instead of fossil fuels has led to the development of many new electrical products. For example, cars, trains, heating systems and domestic products may all be powered by electricity. In some cases it may be advantageous for an electrical product to be powered, at least in part, by an electrical battery. A larger capacity battery typically includes a plurality of cells that are electrically connected to one  
15 another in some way.

- Each cell may include one or more cell terminals that extend from a main body of the cell. The terminals are configured to facilitate electrical connections between the cells and other components. Accordingly, the cell terminals are typically manufactured from a material with high electrical conductivity, such as copper or aluminium. However, such materials typically  
20 have a high degree of ductility and in some cases the cell terminals may be bent or twisted by minimal contact during their manufacture and/or transport. The cells, and in particular the cell terminals, may therefore lack uniformity with significant variation in the orientation and position of the cell terminals. During assembly of a battery comprising a plurality of cells, such variation can lead to significant misalignments between the cell terminals and the components to which  
25 they are to be connected.

- Cell terminal misalignment can be problematic when making the connection between the cell terminals and other components, for example using laser or ultrasonic welding. Misalignment is particularly problematic when using automated manufacturing apparatus to make the connection because the terminals may not be positioned within a tolerable distance of the  
30 component to be connected. Manually adjusting the plurality of cell terminals into the correct position for such assembly operations is time consuming and inefficient.

It is against this background that the present invention has been developed.

## SUMMARY OF THE INVENTION

According to an aspect of the invention there is provided a battery cell terminal alignment fixture for aligning protruding terminals of a plurality of battery cells. The fixture comprises a first alignment component comprising a plurality of first terminal apertures and a respective plurality of associated first engagement surfaces, and a second alignment component comprising a plurality of second terminal apertures and a respective plurality of associated second engagement surfaces. Corresponding first and second terminal apertures are configured to together receive a respective cell terminal. The first and second alignment components are connected together in sliding relation such that sliding one of the first or second alignment components relative to the other alignment component brings corresponding first and second engagement surfaces closer together to thereby clamp a respective battery cell terminal therebetween. Accordingly, the respective battery cell terminal may be clamped between the first and second engagement surfaces in a predetermined controlled position. The battery cell terminal alignment fixture may therefore be used to accurately position respective terminals of a plurality of battery cells in a general sense and also in relation to one another, i.e. in relation to neighbouring cell terminals.

In particular, the cell terminal alignment fixture is configured to receive, i.e. gather, a plurality of differently-positioned and oriented battery cell terminals in respective first and second terminal apertures, in use, and align these in an accurate and repeatable manner. The corresponding pairs of first and second terminal apertures are preferably sized to receive a respective cell terminal with a large tolerance on the actual position and orientation of the cell terminal. The sliding relation between the first and second alignment components then facilitates gathering each respective cell terminal in the first and second terminal apertures irrespective of its initial position and orientation. Bringing corresponding first and second engagement surfaces closer together moves each cell terminal to a specific, predetermined position in a repeatable manner.

In some examples, the battery cell terminal alignment fixture may further comprise a plurality of interconnecting bars mounted in the second alignment component. Each second engagement surface may be at least partially defined by a respective interconnecting bar. Accordingly, the first and second alignment components may be connected together in sliding relation such that sliding one of the first or second alignment components relative to the other alignment component, in use, brings the first engagement surface closer to an interconnecting bar defining the second engagement surface such that a respective battery cell terminal is

brought into contact with the respective interconnecting bar. The interconnecting bars are preferably formed of an electrically conductive material such that bringing a cell terminal into contact with an interconnecting bar, in use, forms an electrical connection between the respective cell terminal and interconnecting bar.

- 5 Further, in some examples each second engagement surface may be entirely defined by an interconnecting bar. This advantageously provides the greatest possible surface area to ensure that a reliable electrical connection can be made between a battery cell terminal and the respective interconnecting bar, in use.

- 10 Mounting the interconnecting bars in the second alignment component advantageously maintains the position of the interconnecting bars relative to one another and the cell terminals. With the interconnecting bars retained in the second alignment component, the risk of accidental electrical contact, i.e. a short circuit, between the interconnecting bars and/or cell terminals is minimised, particularly in examples where the second alignment component is formed of an electrically insulating material.

- 15 In some examples, each first engagement surface may be defined by a respective protrusion that extends into the corresponding second terminal aperture of the second alignment component. Accordingly, the first engagement surface may be arranged directly opposite to the second engagement surface so that the respective battery cell terminal can be clamped between two directly opposed surfaces.

- 20 In some examples, each first engagement surface may comprise an access opening which facilitates access to a side of the respective battery cell terminal engaged by the first engagement surface, in use. The access opening may be a hole, a slot, a gap, or any other opening in the first engagement surface that facilitates access to the respective battery cell terminal, through the first engagement surface. In particular, the access opening may  
25 advantageously facilitate access to the respective battery cell terminal for welding. For example, in some examples wherein the second engagement surface is at least partially defined by a conductive interconnecting bar, the access opening may facilitate access to the battery cell terminal to weld the terminal to the interconnecting bar. Examples of welding to form an electrical connection between a cell terminal and an interconnecting bar may include  
30 laser welding and/or ultrasonic welding.

In some examples, each first engagement surface may be defined by a plurality of spaced-apart protrusions. Accordingly, in such an example the first engagement surface may therefore be defined by a plurality of co-planar partial first engagement surfaces which simultaneously

engage a side of the respective battery cell terminal, in use. It should be understood that in such an example, an access opening may therefore be defined between the spaced-apart protrusions defining the first engagement surface.

5 In some examples, the first alignment component may define a row of first terminal apertures and a row of respective associated first engagement surfaces. It follows that the second alignment component may define a row of second terminal apertures and a row of respective associated second engagement surfaces. With such an arrangement, a plurality of separate battery terminals each received in respective first and second terminal apertures may all be aligned with a single relative sliding motion between the first and second alignment components.  
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In some examples, the first alignment component may define a plurality of rows of first terminal apertures and a plurality of rows of respective associated first engagement surfaces. It follows that the second alignment component may define a plurality of rows of second terminal apertures and a plurality of rows of associated second engagement surfaces. In some preferred examples, the first terminal apertures and associated first engagement surfaces may therefore be arranged in rows and columns to define an array or matrix of first terminal apertures and associated first engagement surfaces. Similarly, in some preferred examples, the second terminal apertures and associated second engagement surfaces may therefore be arranged in rows and columns to define an array or matrix of second terminal apertures and associated second engagement surfaces. A plurality of rows of corresponding first and second terminal apertures facilitates simple alignment of many battery terminals with a single relative sliding motion between the first and second alignment components.  
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In some examples, each pair of corresponding first and second engagement surfaces may be parallel to one another. Such a configuration may help to ensure that when one of the first or second alignment components is moved relative to the other alignment component in use, a respective battery cell terminal may be engaged, i.e. contacted, by as much of the respective engagement surfaces as possible.  
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In some examples, the first and second alignment components may be connected together and restrained relative to one another such that the sliding relation is limited to substantially linear sliding along a sliding axis. Alignment of battery terminals in the corresponding first and second terminal apertures may be simplified by restricting the relative movement of the first and second alignment components to linear movement. The simplicity of the relative movement between the first and second alignment components may also increase the  
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longevity of the alignment fixture. Further, the linear sliding relation means that the distance between the corresponding first and second engagement surfaces increase and/or decreases at the same rate across the whole of the respective surface. This therefore also improves the ability of the alignment components to engage the respective battery cell terminal.

- 5 In some examples, the first and second engagement surfaces may be substantially perpendicular to the sliding axis. Accordingly, a force applied to effect the relative sliding movement between the first and second alignment components may be oriented substantially perpendicular to the engagement surfaces, thereby facilitating a particularly strong engagement of the respective battery cell terminal between the engagement surfaces, in use.
- 10 In some examples, the first and second alignment components may be formed of an electrically insulating material. For example, the first and second alignment components may be plastic components. As previously described, the alignment fixture may be used to align the terminals of a plurality of battery cells, in use, and each cell terminal may be received in a respective pair of corresponding first and second terminal apertures. Accordingly, the
- 15 alignment fixture may advantageously reduce the risk of short circuits between cell terminals because the cell terminals are separated from one another by the electrically insulating alignment components.

- Further, in some preferred examples, the first engagement surface may be electrically insulating. As previously described, the second engagement surface may be defined by an
- 20 electrically conductive interconnecting bar, in some examples. Accordingly, an electrically insulating first engagement surface may clamp the respective battery cell terminal to the respective interconnecting bar, in use, whilst minimising the risk of a short circuit.

- In some examples, the battery cell terminal alignment fixture may further comprise fixing means arranged to fix the first and second alignment components in position relative to one
- 25 another. The fixing means may be used to fix the relative positions of the first and second alignment components after sliding these into a position such that the corresponding first and second engagement surfaces move a respective battery cell terminal into an aligned position. Accordingly, the fixing means may facilitate clamping a respective battery cell terminal between a pair of corresponding first and second engagement surfaces for any desired period
- 30 of time. In some preferred examples, the fixing means may comprise releasable or removable fixing means. As such, releasable fixing means may facilitate rearrangement of the first and second alignment components.

In another aspect of the invention there is provided a battery comprising a plurality of battery cells and a battery cell terminal alignment fixture as described in the examples herein. Each battery cell comprises at least one battery cell terminal, and a terminal of each cell is arranged in a first terminal aperture, in a corresponding second terminal aperture, and between a first engagement surface and a corresponding second engagement surface.

In some examples of the battery, the battery cell terminal alignment fixture may comprise a plurality of interconnecting bars mounted in the second alignment component, and each second engagement surface may be at least partially defined by a respective interconnecting bar. In such an example, each cell terminal arranged in a respective second terminal aperture may be electrically connected to the interconnecting bar defining the associated second engagement surface. Accordingly, the alignment fixture may form an electrical connection between the battery cell terminals and respective interconnecting bars. As previously described, in particular, the alignment fixture may hold or clamp the cell terminals to respective interconnecting bars.

In some examples, each battery cell may comprise a positive battery cell terminal and a negative battery cell terminal. The positive and negative battery cell terminals may both protrude from the same side of the respective battery cell. In some preferred examples, the battery cells may be arranged in substantially the same orientation in the battery such that all of the battery cell terminals are arranged on the same side of the battery. Accordingly, in some examples all of the battery cell terminals may be aligned using the same battery cell terminal alignment fixture described in any of the examples herein.

In such an example, and where the alignment fixture comprises a plurality of interconnecting bars mounted in the second alignment component, the interconnecting bars may be configured to electrically connect the positive terminal of a cell to the negative terminal of another cell. Accordingly, the alignment fixture may be configured to electrically connect a plurality of cells in series. Alternatively, the interconnecting bars may be configured to electrically connect the positive terminal of a cell to the positive terminal of another cell, and the negative terminal of a cell to a negative terminal of another cell. Accordingly, the alignment fixture may be configured to electrically connect a plurality of cells in parallel.

In some other examples, each battery cell may comprise a positive battery cell terminal and a negative battery cell terminal, and the positive and negative battery cell terminals may each protrude from different sides of the respective battery cell. In some preferred examples, the

positive and negative terminals may protrude from opposing sides of the respective cell. This may be advantageous for manufacturing and assembly of the battery.

- In some examples where the battery comprises cells having cell terminals extending from different sides of the respective cell, the battery cells may be oriented alternately such that the battery comprises a plurality of positive and negative cell terminals protruding on both a first side and a second side of the battery. The alignment fixture may be arranged on the first side of the battery and may comprise a plurality of interconnecting bars mounted in the second alignment component. The interconnecting bars may be configured to electrically connect the positive terminal of a cell to the negative terminal of another cell. In such an example the alignment fixture may therefore be configured to electrically connect a plurality of cells in series. A second alignment fixture may be arranged on the second side of the battery in some examples and may comprise a plurality of interconnecting bars mounted in its second alignment component. The interconnecting bars may be configured to electrically connect the negative terminal of a cell to the positive terminal of another cell for the in-series connection.
- In some other examples where the battery comprises cells having cell terminals extending from different sides of the respective cell, the battery cells may be arranged in substantially the same orientation in the battery. Accordingly, all of the positive terminals may protrude on the first side of the battery and all of the negative cell terminals may protrude on a second side of the battery. The alignment fixture may be arranged on a first side of the battery and may comprise a plurality of interconnecting bars mounted in the second alignment component. The interconnecting bars may be configured to electrically connect the positive terminal of a cell to the positive terminal of another cell. In such an example the alignment fixture may therefore be configured to electrically connect a plurality of cells in parallel. In some such examples, the battery may comprise a second alignment fixture arranged on the second side of the battery and comprising a plurality of interconnecting bars mounted in its second alignment component. The interconnecting bars may be configured to electrically connect the negative terminal of a cell to the negative terminal of another cell.

- As described in the examples presented above, where included, the interconnecting bars of an alignment fixture may perform different functions in different examples. For example, each interconnecting bar may electrically connect a positive battery cell terminal of a battery cell to a negative battery cell terminal of a different battery cell. Accordingly, in some examples, the battery cells in the battery may be electrically connected to one another in series. Alternatively, in other examples each interconnecting bar may electrically connect a positive battery cell terminal of a battery cell to a positive battery cell terminal of a different battery cell, or may

connect a negative battery cell terminal of a battery cell to a negative battery cell terminal of a different battery cell. Accordingly, in some examples, the battery cells in the battery may be electrically connected to one another in parallel.

In some examples, each interconnecting bar may comprise a connection pin. The battery may  
5 further comprise a battery management control board electrically connected to each interconnecting bar via the respective connection pin. In some examples, the control board may be operable to vary the voltage across each interconnecting bar and therefore across each cell in the battery.

In some examples, each battery cell terminal arranged in a first and second terminal aperture  
10 of the battery cell terminal alignment fixture may be individually arranged in its own first terminal aperture and corresponding second terminal aperture. In some examples this may help to reduce the risk of unwanted electrical contact between terminals of different cells.

In some other examples, corresponding first and second terminal apertures of the alignment  
15 fixture may be configured to together receive a plurality of cell terminals. Accordingly, each battery cell terminal arranged in a first and second terminal aperture of the battery cell terminal alignment fixture may be arranged in the respective first and second terminal apertures with one or more other battery cell terminals. As such, in some examples the battery may comprise a positive cell terminal received in the same first and second terminal apertures as a positive cell terminal of a different cell. In some examples, the battery may comprise a negative cell  
20 terminal received in the same first and second terminal apertures as a negative cell terminal of a different cell. In some examples the battery may comprise a positive cell terminal received in the same first and second terminal apertures as a negative cell terminal of a different cell.

In examples comprising multiple cell terminals received in a respective first and second  
25 terminal aperture, an electrical connection may be formed, in use, between the terminals in the respective first and second terminal apertures. For example, such an electrical connection may be formed by sliding one of the first or second alignment components relative to the other alignment component to bring corresponding first and second engagement surfaces closer together to engage the cell terminals in the respective first and second terminal apertures and bring these into electrical contact with one another. It follows that in some examples, an  
30 electrical connection may be formed between a plurality of cell terminals without using an interconnecting bar to connect the terminals.

In some examples, the battery may further comprise a cell housing defining a plurality of cell compartments. Each battery cell may be arranged in a cell compartment such that the cells

are held in position relative to one another. In some preferred examples, each cell may be individually located in its own respective cell compartment. As such, in some examples, each cell compartment may comprise a single cell. The cell compartments defined by the cell housing may be advantageous for organising and aligning the cells facilitating a faster and more efficient process for connecting the cell terminals using the alignment fixture during manufacture of the battery.

In some examples, the cell compartments of the cell housing may be defined in a stacked configuration on top of one another. In other words, each cell compartment may be adjacent to (on top of or below) at least one other cell compartment of the cell housing. A stacked configuration may be space-efficient whilst still facilitating effective heat transfer between the cell compartments and the cooling duct. Additionally, such a configuration may help to retain the cells in a particularly advantageous arrangement for aligning the respective cell terminals simultaneously using the alignment fixture.

In some examples, the cell housing may further define a cooling duct thermally coupled to the cell compartments. Each cell compartment may be directly thermally coupled to the cooling duct, e.g. if the cell compartment and cooling duct are defined by a single, monolithic component, or indirectly thermally coupled via a separate conductive component. Individually locating a cell in its own cell compartment may be particularly effective for transferring heat away from the cell, to the cooling duct, in use.

The term “thermally coupled” should be understood to refer to the facility for transferring heat between the cell compartments and the cooling duct of the cell housing. Conversely, for context, if a component is thermally insulated it is not thermally coupled to another component. For example, such a thermally insulated component may be separated from another component by a thermally insulating material.

In some examples, the battery cell terminal alignment fixture may be attached to the cell housing. Further, in some examples, at least one of the first alignment component or the second alignment component may be slidable relative to the cell housing. Accordingly, with the cells retained in position in the cell housing, one of the alignment components may be moved relative to the other alignment component and the cell housing such that the cell terminals are engaged between respective first and second engagement surfaces thereby facilitating the alignment of the terminals. In some preferred examples, both the first alignment component and the second alignment component may be slidable relative to the cell housing.

It follows that in some preferred examples, the first and/or second alignment components may be linearly slidable relative to one another and the cell housing along the sliding axis.

In another aspect of the invention there is provided an electric water heating system comprising a battery cell terminal alignment fixture according to any of the examples described  
5 herein.

In another aspect of the invention there is provided an electric water heating system comprising a battery according to any of the examples described herein. The electric water heating system may further comprise an electrical heating device for heating water. The battery may be electrically coupled to the electrical heating device for supplying electrical  
10 power to the electrical heating device.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a battery cell terminal alignment fixture;

15 Figure 2a is a schematic perspective view of a reverse side of a first alignment component of the battery cell terminal alignment fixture;

Figure 2b is a schematic perspective view of a reverse side of a second alignment component of the battery cell terminal alignment fixture;

20 Figure 3 is a schematic perspective view of a battery including a plurality of cells and the battery cell terminal alignment fixture;

Figure 4a is a schematic cross-sectional side view of the battery and alignment fixture;

Figure 4b is a schematic close-up view of a terminal aperture of the alignment fixture;

Figure 5a is a schematic perspective view of a cell housing retaining a plurality of cells; and

25 Figure 5b is a schematic perspective view of an example of the battery including the cell housing.

#### DETAILED DESCRIPTION

Figure 1 is a schematic perspective view of a battery cell terminal alignment fixture 10 for aligning protruding terminals 12 of a plurality of battery cells 14 (shown in Figure 3). As described in more detail below, the alignment fixture 10 advantageously facilitates simultaneous alignment of a plurality of cell terminals, for example during the manufacture and assembly of a battery 16. A battery 16 including a plurality of cells 14 and a cell terminal alignment fixture 10 is shown in Figures 3 to 5b, but reference will be made initially to Figures 1 to 2b which show the alignment fixture 10 itself in more detail.

As shown in Figure 1, the battery cell terminal alignment fixture 10 includes a first alignment component 18a and a second alignment component 18b. As shown more clearly in Figure 2a, which shows a schematic rear perspective view, the first alignment component 18a features a plurality of first terminal apertures 20a associated with respective first engagement surfaces 22a. Similarly, as shown more clearly in the rear perspective view of Figure 2b, the second alignment component 18b features a plurality of second terminal apertures 20b associated with respective second engagement surfaces 22b. The second terminal apertures 20b and associated second engagement surfaces 22b correspond to respective first terminal apertures 20a and engagement surfaces 22a. As will be described in more detail later with reference to the remaining figures, each set of corresponding first and second terminal apertures 20a, 20b is configured to receive a battery cell terminal 12. Accordingly, when assembling a battery 16, terminals 12 of a plurality of cells 14 may be inserted into respective corresponding first and second terminal apertures 20a, 20b (as shown in Figure 3).

The first and second alignment components 18a, 18b are connected together in sliding relation, i.e. at least one of the alignment components 18a, 18b is slidable relative to the other alignment component. As described later in more detail, the sliding relation between the first and second alignment components 18a, 18b facilitates the capture, or gathering, of a cell terminal 12 between the first and second engagement surfaces 22a, 22b and the subsequent manipulation of the cell terminal 12 into an aligned position, even if the cell terminal 12 is initially misaligned or bent out of position.

Referring still to Figures 1 to 2b, the first alignment component 18a may define a row of first terminal apertures 20a and associated first engagement surfaces 22a in some examples, and similarly the second alignment component 18b may define a corresponding row of second terminal apertures 20b and associated second engagement surfaces 22b. Further to this, as shown in the example of Figures 1 to 2b, the first and second alignment components 18a, 18b may each define a plurality of rows of respective first and second terminal apertures 20a, 20b in some examples. Each alignment component 18a, 18b may therefore have a matrix or grid

of terminal apertures 20a, 20b and associated engagement surfaces 22a, 22b such that the terminals 12 of many cells 14 can be aligned simultaneously with a simple relative sliding motion between the two alignment components 18a, 18b.

As shown in Figure 1 and 2a, in some preferred examples the various first engagement  
5 surfaces 22a of the first alignment component 18a may be defined by respective protrusions 24. The protrusions 24 preferably extend, i.e. protrude, from a substantially planar face of the first alignment component 18a, for example from a sliding surface 26 against which the second alignment component 18b may be arranged to slide. With the first and second alignment components 18a, 18b assembled together in the alignment fixture 10, the protrusions 24  
10 defining the first engagement surfaces 22a may extend into the respective second terminal aperture 20b associated with the corresponding second engagement surface 22b. This enables the arrangement of the engagement surfaces 22a, 22b substantially directly opposite to one another, in some examples. Further, as described in more detail later with additional reference to Figure 4b, in some examples the various first engagement surfaces 22a may  
15 each be defined by multiple spaced-apart protrusions 24, also shown in Figure 2a. Accordingly, the first engagement surfaces 22a may comprise an access opening 28 allowing access to a respective cell terminal 12 engaged by the first engagement surface 22a.

With reference to Figure 2b in particular, the alignment fixture 10 may also include a plurality of interconnecting bars 30 mounted in the second alignment component 18b. Where included,  
20 the interconnecting bars 30 are preferably mounted in the second alignment component 18b such that each second engagement surface 22b is at least partially defined by a respective interconnecting bar 30. Accordingly, engaging a cell terminal 12 with the second engagement surface 22b in use may result in contact between a cell terminal 12 and a respective interconnecting bar 30. In particular, the interconnecting bars 30 may be formed of an  
25 electrically conductive material such that an electrical connection may be formed when the second engagement surface 22b is contacted by a cell terminal 12. The interconnecting bars 30 may electrically connect the terminals 12 of different cells 14 in the battery 16 as described later in more detail.

Reference is now made to Figure 3, which shows a schematic perspective view of a battery  
30 16 including an example of the cell terminal alignment fixture 10 described previously. The battery 16 includes a plurality of cells 14 which each have at least one battery cell terminal 12. For example, as shown in Figure 3, the cells 14 may each comprise two terminals 12, such as a positive terminal 12a and a negative terminal 12b. The alignment fixture 10 is included with the battery 16 to align the cell terminals 12. Accordingly a terminal 12 of each cell 14 is

arranged in a first terminal aperture 20a, in a corresponding second terminal aperture 20b, and between a first engagement surface 22a and a corresponding second engagement surface 22b.

5 In the battery 16 shown by way of example in Figure 3, the battery cells 14 each comprise positive and negative terminals 12a, 12b that both protrude from the same side of the respective cell 14. In such an example, if interconnecting bars 30 are also included then the bars 30 may be configured to connect the cells 14 in series, i.e. by electrically connecting a negative terminal 12b of a cell 14 to a positive terminal 12a of a different cell 14, or in parallel, i.e. by each electrically connecting either negative terminals 12b of different cells 14 or positive  
10 terminals 12a of different cells 14. In preferred examples, the first and second alignment components 18a, 18b may be formed of an electrically insulating material, such as plastic, to minimise the risk of short circuits and to ensure that electricity is only conducted along the desired routes, such as those defined by the interconnecting bars 30 when included.

With reference still to Figure 3, in some examples the corresponding pairs of first and second  
15 terminal apertures 20a, 20b may each receive a single cell terminal 12. In other words, each battery cell terminal 12 may be individually arranged in its own first terminal aperture 20a and corresponding second terminal aperture 20b. This may be advantageous for alignment of the cell terminals 12 and may also reduce the risk of undesired electrical contact, i.e. short circuits, between the terminals 12 of cells 14 in the battery 16.

20 Figure 4a shows a schematic cross-sectional view of a portion of the battery 16 through the line A-A in Figure 3. The cross-sectional view shows the alignment fixture 10 arranged with the battery cells 14, with terminals 12 of the cells 14 extending through the terminal apertures 20a, 20b defined by the first and second alignment components 18a, 18b, as described previously.

25 The result, or effect, of the sliding relation between the first and second alignment components 18a, 18b is shown clearly in the example of Figure 4a. As previously described, sliding one of the first or second alignment components 18a, 18b relative to the other alignment component brings corresponding first and second engagement surfaces 22a, 22b closer together. A cell terminal 12 received in the corresponding first and second terminal apertures 20a, 20b is  
30 therefore engaged between the first and second engagement surfaces 22a, 22b as a result of the sliding movement. As shown in Figure 4a, in examples where the cell terminals 12 are individually arranged in their own first and second terminal apertures 20a, 20b, associated first

and second engagement surfaces 22a, 22b may engage opposing sides of a respective cell terminal 12.

Referring still to Figure 4a, in some examples the corresponding first and second engagement surfaces 22a, 22b may be substantially parallel to one another. This maximises the surface area of each engagement surface 22a, 22b that contacts a respective cell terminal 12 when the first and second alignment components 18a, 18b are slid together, thereby providing more grip for aligning and holding the cell terminals 12 in position.

The first and second alignment components 18a, 18b are preferably connected together and restrained relative to one another to limit the sliding relation to substantially linear sliding. Accordingly, the relative sliding relation may be restrained to linear sliding movement along a sliding axis S. This simple relation helps to reduce wear and improves useability of the alignment fixture 10. Additionally, in some examples the first and second engagement surfaces 22a, 22b may be substantially perpendicular to the sliding axis S. Such a configuration facilitates the application of substantially all of a sliding force applied to the first and/or second alignment components 18a, 18b as a clamping force engaging a respective terminal 12 between the corresponding first and second engagement surfaces 22a, 22b.

Reference is now made to Figure 4b which shows a schematic close-up view of a plurality of terminal apertures 20a, 20b and associated engagement surfaces 22a, 22b. In some examples, the cell terminals 12 extending into the terminal apertures 20a, 20b may be electrically connected to other cell terminals 12 or other components following alignment in the alignment fixture 10. Accordingly, in some examples the first engagement surfaces 22a may each comprise an access opening 28 which facilitates access to a side of the respective battery cell terminal 12 engaged by the first engagement surface 22a, in use. As described previously, in the examples shown in the preceding figures, the first engagement surfaces 22a may be respectively defined by a plurality of spaced apart protrusions 24. It follows that in some examples the access opening 28 of each first engagement surface 22a may be defined between two or more protrusions 24 that define the first engagement surface 22a.

In particular, in examples where the alignment fixture 10 comprises interconnecting bars 30 defining the second engagement surfaces 22b, an access opening 28 may be advantageous to facilitate access to a side of the respective cell terminal 12 for welding the respective terminal 12 to an interconnecting bar 30. Parallel engagement surfaces 22a, 22b are also advantageous in such an example to ensure that a flat, parallel, interface is provided between

the respective terminal 12 and interconnecting bar 30 to enable a high-quality electrical connection to be formed between the terminal 12 and bar 30.

Referring now to Figure 5a, in some examples the battery 16 may include a cell housing 32 for arranging and retaining the cells 14. For example, the cell housing 32 may define a plurality  
5 of cell compartments 34 and each cell 14 of the battery 16 may be arranged in a cell compartment 34. Accordingly, the cells 14 may be restrained and held in position relative to one another. In some examples, the cells 14 may be bonded into the respective cell compartment 34 in which they are arranged, to secure the cell 14 in position.

As shown in Figure 5b, in some examples the cell terminal alignment fixture 10 may be  
10 attached to the cell housing 32 to align the terminals 12 of cells 14 held in the cell housing 32. For example, with the cells 14 restrained in position in the cell housing 32, the flexible terminals 12 of the cells 14 may then be manipulated by the cell terminal alignment fixture 10, in particular by the engagement surfaces 22a, 22b of the first and second alignment components 18a, 18b, to align the cell terminals 12, as described previously. It follows that at least one of  
15 the first alignment component 18a or the second alignment component 18b, and in some preferred examples, both alignment components, may therefore be slidable relative to the cell housing 32 to facilitate alignment of the terminals 12 as previously described.

Still with reference to Figure 5b, in some examples the alignment fixture 10 may be provided with fixing means (not shown) for fixing the first and second alignment components 18a, 18b  
20 in position relative to one another. The fixing means may comprise one or more bolts located at a fixing location 36 which are configured to clamp the alignment components 18a, 18b together. Advantageously in examples comprising a cell housing 32, the fixing means may be multi-functional and may additionally attach the alignment fixture 10 to the cell housing 32.

Where included, the fixing means may help to hold the first and second alignment components  
25 18a, 18b in position relative to one another after sliding the components to engage cell terminals 12 between the respective first and second engagement surfaces 22a, 22b. Accordingly, the fixing means may help to maintain an electrical connection between the cell terminals 12 and other components that they are held against, in some examples. Where the cell terminals 12 are to be welded to another component, such as an interconnecting bar 30  
30 or another cell terminal 12, the fixing means may help to maintain the cell terminals 12 in the correct position until the welding process is complete.

It will be appreciated that the description provided with reference to the accompanying figures serves to provide a plurality of non-exclusive examples of the invention defined by the

appended claims. Accordingly, it should be appreciated that other examples that are not shown in the accompanying figures may form part of the invention, in some examples.

For example, whilst the cell terminals 12 of cells 14 in the battery 16 shown in Figures 3 to 5b each protrude from the same side of the cell 14 and the cells 14 are all arranged in the same orientation, in some other examples the cells 14 may be configured and arranged differently. For example, each battery cell 14 may have positive and negative cell terminals 12a, 12b which each protrude from different sides of the respective cell 14. Examples including such battery cells 14 may feature an arrangement of cells 14 oriented the same way such that all positive terminals 12a protrude on a first side of the battery 16 and all negative terminals 12b protrude on a second side of the battery 16. Alternatively, other examples including such cells 14 may feature cells arranged in a plurality of different orientations such that a first side of the battery 16 may comprise both positive and negative cell terminals 12a, 12b and a second side of the battery 16 may also comprise both positive and negative cell terminals 12a, 12b.

In each example it will be appreciated that the cell terminal alignment fixture 10 described herein may be used to align a plurality of terminals 12 on a given side of the battery 16, and in some examples the alignment fixture 10 may facilitate electrical connection of the cells 14 as previously described. For example, where included interconnecting bars 30 of the fixture 10 may connect positive cell terminals 12a together, negative cell terminals 12b together, and/or positive and negative cell terminals 12a, 12b together, dependent on the desired characteristics of the battery 16, as previously described.

Further to this, in examples where the cells 14 feature terminals 12 extending from different sides of the respective cell 14, the battery 16 may include a plurality of cell terminal alignment fixtures 10, with each fixture 10 arranged to align the terminals 12 on a respective side of the battery 16. Accordingly, some examples of the battery 16 may include a first alignment fixture 10 arranged on a first side of the battery 16 for aligning terminals 12 protruding from a respective first side of a plurality of cells 14, and a second alignment fixture 10 arranged on a second side of the battery 16 for aligning terminals 12 protruding from a respective second side of a plurality of cells 14.

As described previously with reference to Figure 3, in some examples each cell terminal 12 may be individually arranged in its own corresponding first and second terminal apertures 20a, 20b. However, whilst not shown in the accompanying figures, in some examples a corresponding first and second terminal aperture 20a, 20b may receive a plurality of cell terminals 12. Accordingly, sliding one or both of the alignment components 18a, 18b to bring

the first and second engagement surfaces 22a, 22b together may gather a plurality of terminals 12 between each pair of corresponding engagement surfaces 22a, 22b, and further sliding may bring the cell terminals 12 into contact with one another. Accordingly configuring the alignment fixture 10 to receive a plurality of cell terminals 12 in each terminal aperture 20a, 20b may facilitate direct connection between a plurality of terminals 12 arranged in the respective apertures 20a, 20b.

Whilst not shown in the accompanying figures, some examples of the battery 16 described herein may include a battery management control board. Such a control board may be configured to control the voltage across the cells 14 in the battery 16. In examples comprising interconnecting bars 30, a control board may therefore be electrically connected to each bar 30. For example, as shown in Figure 5b, in some examples the interconnecting bars 30 may each include a respective connection pin 38, and a control board (not shown) may be electrically coupled to the respective interconnecting bars 30 via such connection pins 38. For ease of connection, such pins 38 may preferably extend outwardly from the battery 16 such that a control board can be mounted to the battery 16 at a later stage in the assembly process, after the cell terminals 12 have been aligned in the fixture 10, and preferably after any electrical connections have been made.

The cell terminal alignment fixture 10 or battery 16 described herein may form part of an electric water heating system (not shown). For example, an electric water heating system may include a battery 16 for providing electrical power to an electric water heating device, such as a resistive heating element. Accordingly the battery 16 may be electrically coupled to the electric water heating device.

It should be appreciated that in some other examples the cell terminal alignment fixture 10 or battery 16 described herein may also be advantageously implemented in other applications utilising a plurality of cells 14 connected together, i.e. utilising an electric battery 16. For example, the alignment fixture 10 or battery 16 may also be used in the field of transport, for example on boats, trains, or in vehicles, or the field of power systems for example for commercial or domestic properties, or backup power storage devices, to name a few non-limiting examples.

It will be appreciated that any features described in relation to the various examples above may be readily combined with any other features described with reference to different examples without departing from the scope of the invention as defined in the appended claims. Further, it will be appreciated that the above description and accompanying figures are

provided merely as an example. Many alternatives to the specific examples provided above are therefore possible without departing from the scope of the invention as defined in the appended claims.

## CLAIMS

1. A battery cell terminal alignment fixture (10) for aligning protruding terminals (12) of a plurality of battery cells (14), the fixture comprising:
- 5 a first alignment component (18a) comprising a plurality of first terminal apertures (20a) and a respective plurality of associated first engagement surfaces (22a); and
- a second alignment component (18b) comprising a plurality of second terminal apertures (20b) and a respective plurality of associated second engagement surfaces (22b);
- wherein corresponding first and second terminal apertures (20a, 20b) are configured to together receive a respective battery cell terminal (12); and
- 10 wherein the first and second alignment components (18a, 18b) are connected together in sliding relation such that sliding one of the first or second alignment components relative to the other alignment component brings corresponding first and second engagement surfaces (22a, 22b) closer together to thereby clamp a respective battery cell terminal (12) therebetween.
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2. The battery cell terminal alignment fixture (10) of Claim 1, further comprising a plurality of interconnecting bars (30) mounted in the second alignment component (18b), wherein each second engagement surface (22b) is at least partially defined by a respective interconnecting bar.
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3. The battery cell terminal alignment fixture (10) of Claim 2, wherein each first engagement surface (22a) is defined by a respective protrusion (24) that extends into the corresponding second terminal aperture (20b) of the second alignment component (18b).
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4. The battery cell terminal alignment fixture (10) of Claim 3, wherein each first engagement surface (22a) comprises an access opening (28) which facilitates access to a side of the respective battery cell terminal (12) engaged by the first engagement surface, in use.
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5. The battery cell terminal alignment fixture (10) of Claim 3 or Claim 4, wherein each first engagement surface (22a) is defined by a plurality of spaced-apart protrusions (24).
6. The battery cell terminal alignment fixture (10) of any preceding claim, wherein the
- 35 first alignment component (18a) defines a row of first terminal apertures (20a) and a row of

respective associated first engagement surfaces (22a), and wherein the second alignment component (18b) defines a row of second terminal apertures (20b) and a row of respective associated second engagement surfaces (22b).

- 5 7. The battery cell terminal alignment fixture (10) of Claim 6, wherein the first alignment component (18a) defines a plurality of rows of first terminal apertures (20a) and a plurality of rows of respective associated first engagement surfaces (22a), and wherein the second alignment component (18b) defines a plurality of rows of second terminal apertures (20b) and a plurality of rows of respective associated second engagement surfaces (22b).

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8. The battery cell terminal alignment fixture (10) of any preceding claim, wherein each pair of corresponding first and second engagement surfaces (22a, 22b) are parallel to one another.

- 15 9. The battery cell terminal alignment fixture (10) of any preceding claim, wherein the first and second alignment components (18a, 18b) are connected together and restrained relative to one another such that the sliding relation is limited to substantially linear sliding along a sliding axis S.

- 20 10. The battery cell terminal alignment fixture (10) of Claim 9, wherein the first and second engagement surfaces (22a, 22b) are substantially perpendicular to the sliding axis S.

11. The battery cell terminal alignment fixture (10) of any preceding claim, wherein the first and second alignment components (18a, 18b) are formed of an electrically insulating material.

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12. The battery cell terminal alignment fixture (10) of any preceding claim, further comprising fixing means arranged to fix the first and second alignment components (18a, 18b) in position relative to one another.

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13. A battery (16) comprising a plurality of battery cells (14) and the battery cell terminal alignment fixture (10) of any preceding claim, each battery cell comprising at least one battery cell terminal (12), and a terminal of each cell being arranged in a first terminal aperture (20a), in a corresponding second terminal aperture (20b), and between a first engagement surface (22a) and a corresponding second engagement surface (22b).

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14. The battery (16) of Claim 13, wherein the battery cell terminal alignment fixture (10) comprises a plurality of interconnecting bars (30) mounted in the second alignment component (18b), wherein each second engagement surface (22b) is at least partially defined by a respective interconnecting bar, and wherein each cell terminal (12) arranged in  
5 a respective second terminal aperture (20b) is electrically connected to the interconnecting bar defining the associated second engagement surface.

15. The battery (16) of Claim 14, wherein each battery cell (14) comprises a positive battery cell terminal (12a) and a negative battery cell terminal (12b), and wherein the positive  
10 and negative battery cell terminals both protrude from the same side of the respective battery cell.

16. The battery (16) of Claim 14, wherein each battery cell (14) comprises a positive battery cell terminal (12a) and a negative battery cell terminal (12b), and wherein the positive  
15 and negative battery cell terminals each protrude from different sides of the respective battery cell.

17. The battery (16) of Claim 15 or 16, wherein each interconnecting bar electrically connects a positive battery cell terminal (12a) of a battery cell (14) to a negative battery cell  
20 terminal (12b) of a different battery cell.

18. The battery (16) of Claim 15 or 16, wherein each interconnecting bar (30) electrically connects a positive battery cell terminal (12a) of a battery cell (14) to a positive battery cell terminal (12a) of a different battery cell, or wherein each interconnecting bar electrically  
25 connects a negative battery cell terminal (12b) of a battery cell to a negative battery cell terminal (12b) of a different battery cell.

19. The battery (16) of any of Claims 14 to 18, wherein each interconnecting bar (30) comprises a connection pin (38), and wherein the battery further comprises a battery  
30 management control board electrically connected to each interconnecting bar via the respective connection pin.

20. The battery (16) of any of Claims 13 to 19, wherein each battery cell terminal (12) arranged in a first and second terminal aperture (20a, 20b) of the battery cell terminal alignment fixture (10) is individually arranged in its own first terminal aperture and  
35 corresponding second terminal aperture.

21. The battery (16) of any of Claims 13 to 20, further comprising a cell housing (32) defining a plurality of cell compartments (34), wherein each battery cell (14) is arranged in a cell compartment such that the cells are held in position relative to one another.

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22. The battery (16) of Claim 21, wherein the battery cell terminal alignment fixture (10) is attached to the cell housing (32).

23. The battery (16) of Claim 22, wherein at least one of the first alignment component (18a) or the second alignment component (18b) is slidable relative to the cell housing (32).

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24. The battery (16) of Claim 23, wherein both the first alignment component (18a) and the second alignment component (18b) are slidable relative to the cell housing (32).

25. An electric water heating system comprising the battery cell terminal alignment fixture (10) of any of claims 1 to 12.

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26. An electric water heating system comprising the battery (16) of any of Claims 13 to 24.

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27. The electric water heating system of Claim 26, further comprising an electrical heating device for heating water, wherein the battery (16) is electrically coupled to the electrical heating device for powering the electrical heating device.

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