

(12) UK Patent

(19) GB

(11) 2589081

(13) B

(45) Date of B Publication

09.03.2022

(54) Title of the Invention: **Battery pack for a vacuum cleaner**

(51) INT CL: **H01M 50/247** (2021.01) **A47L 9/28** (2006.01) **H01M 50/213** (2021.01) **H01M 50/244** (2021.01)
H01M 50/296 (2021.01) **H01M 50/543** (2021.01) **H01M 50/545** (2021.01) **A47L 5/24** (2006.01)
A47L 5/28 (2006.01)

(21) Application No: **1916275.9**

(22) Date of Filing: **08.11.2019**

(43) Date of A Publication: **26.05.2021**

(72) Inventor(s):

Charles Franklin Gale
Stuart Lloyd Genn
Daryl Robert Sage
Alan John Lea
Matthew Adam Tucker
Sophie Louise Sheriff

(56) Documents Cited:

GB 2546733 A **GB 2502819 A**
GB 2468719 A **WO 2013/117901 A1**
US 20050280393 A1

(73) Proprietor(s):

Dyson Technology Limited
Tetbury Hill, Malmesbury, Wiltshire, SN16 0RP,
United Kingdom

(58) Field of Search:

As for published application 2589081 A viz:
INT CL **A47L, B25F, H01M**
Other: **WPI, EPODOC**
updated as appropriate

Additional Fields
Other: **None**

(74) Agent and/or Address for Service:

Dyson Technology Limited
Intellectual Property Department, Tetbury Hill,
MALMESBURY, Wiltshire, SN16 0RP, United Kingdom

GB 2589081 B

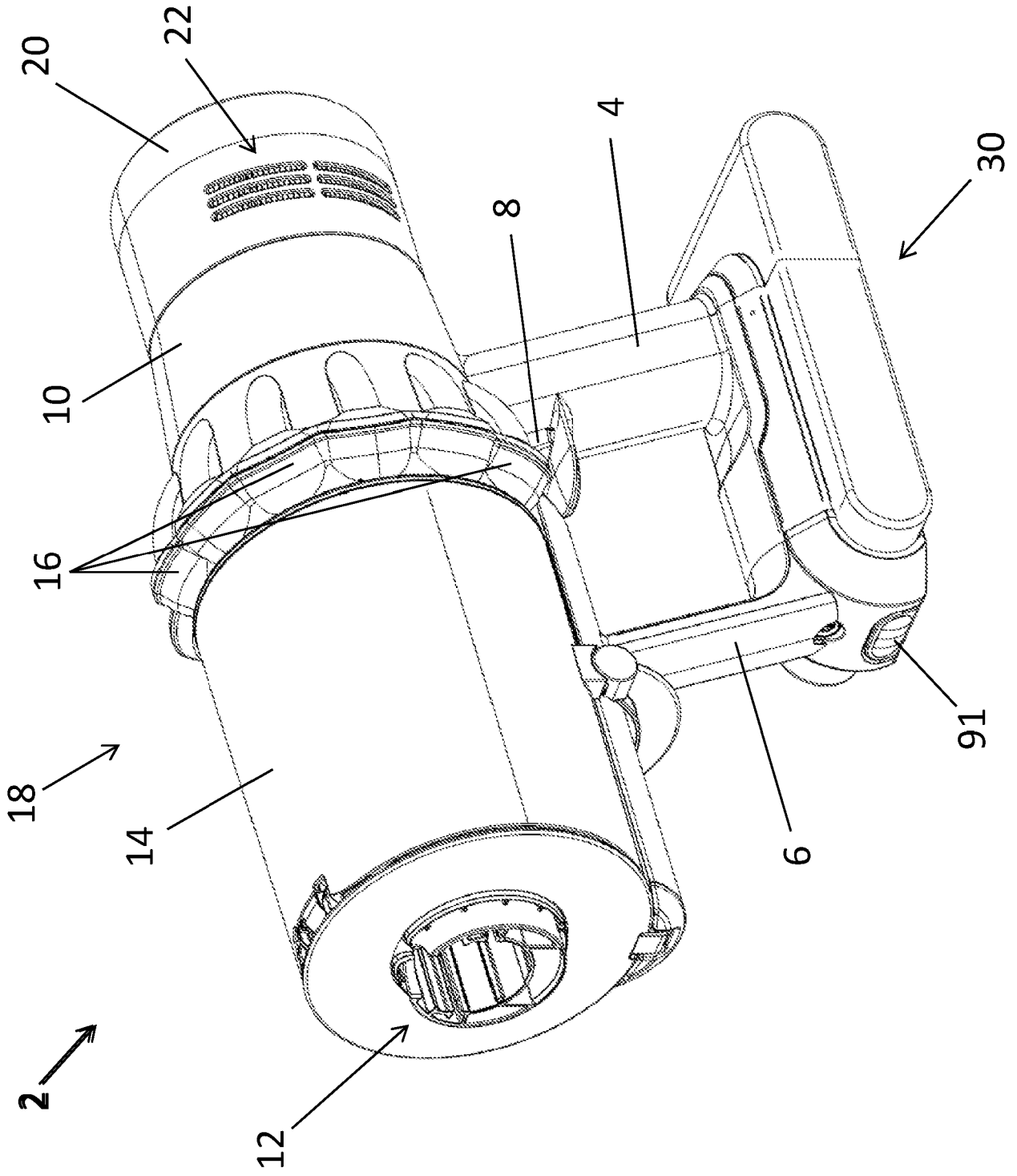


Fig. 1

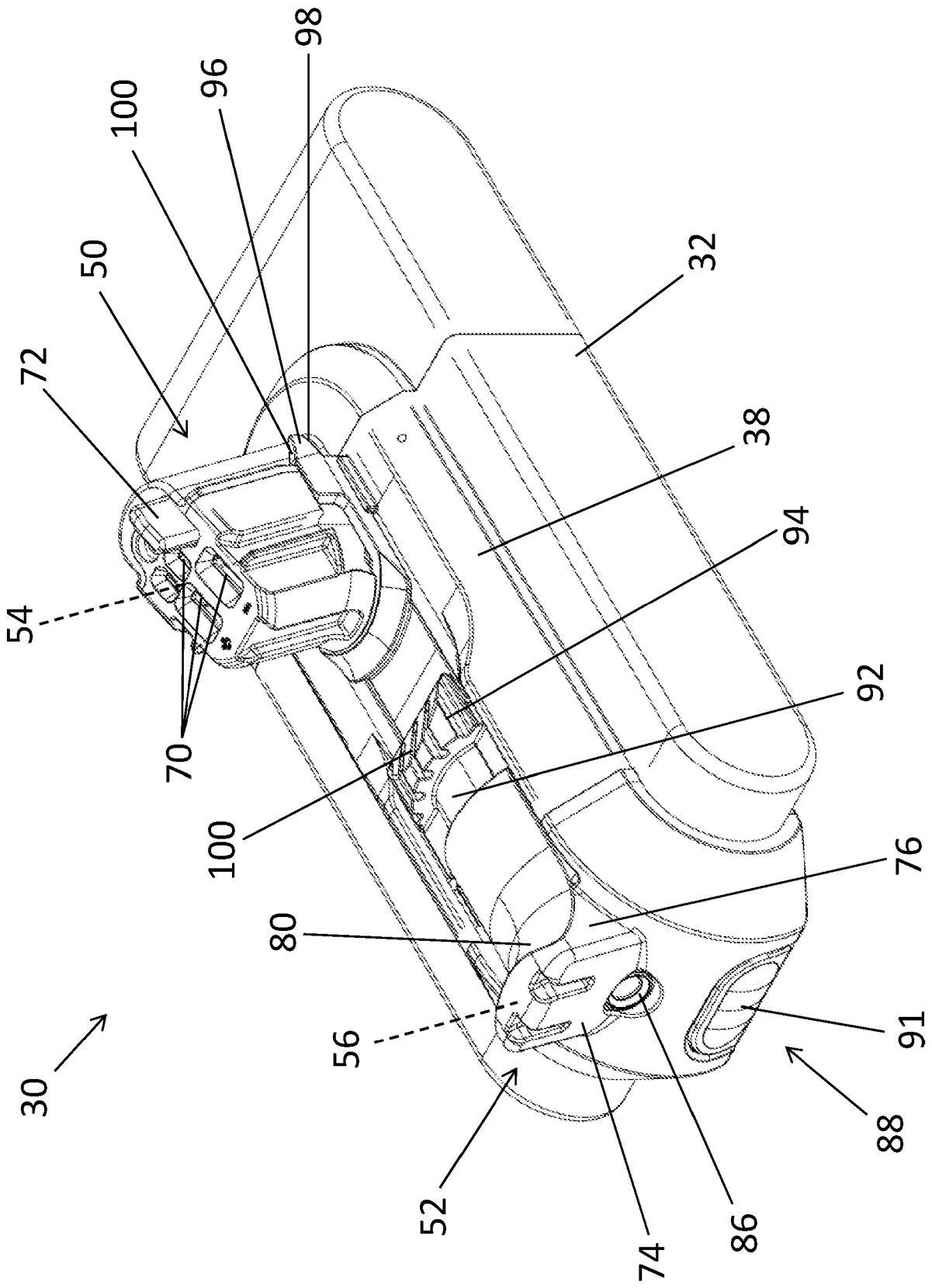


Fig. 2

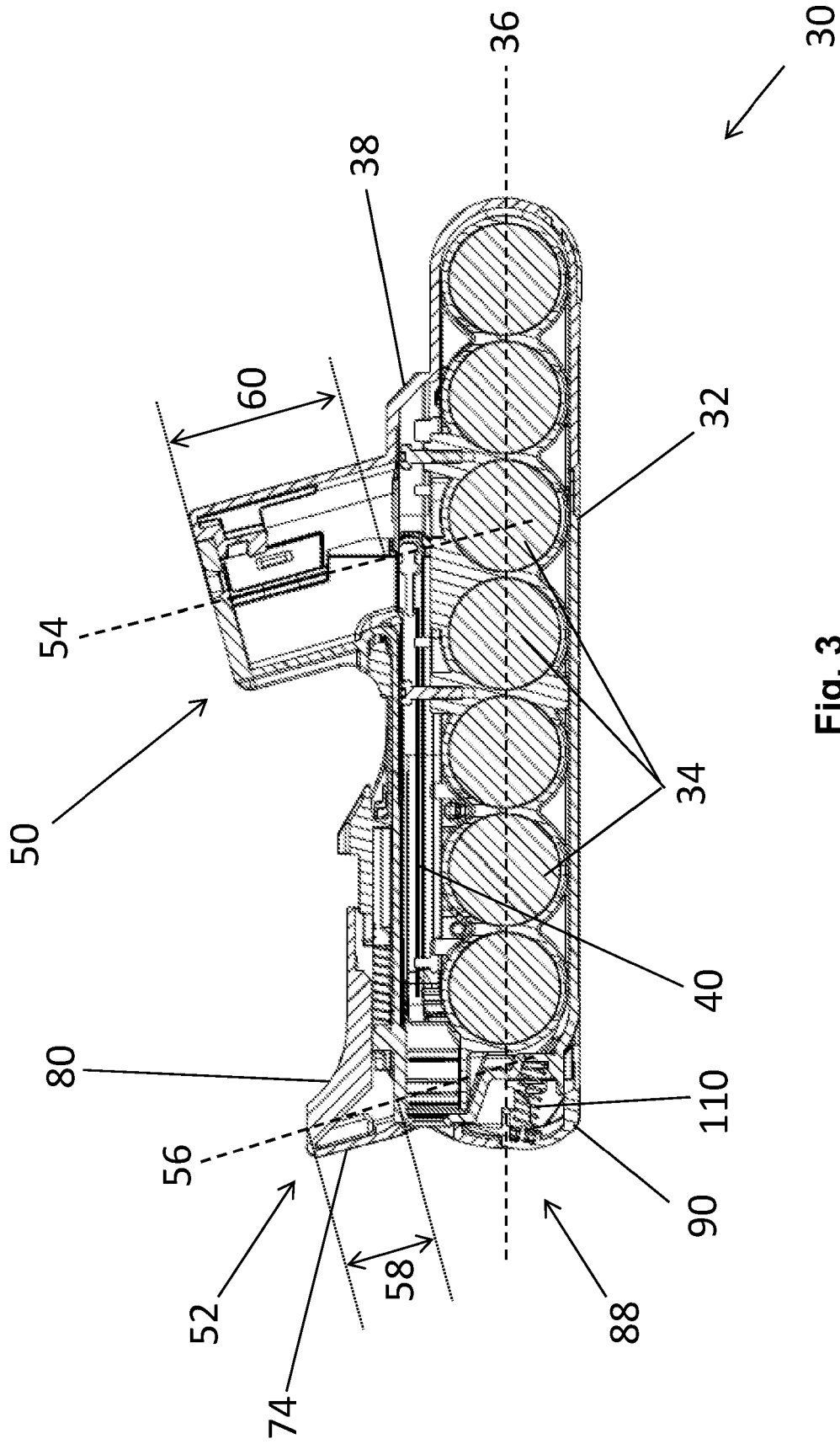


Fig. 3

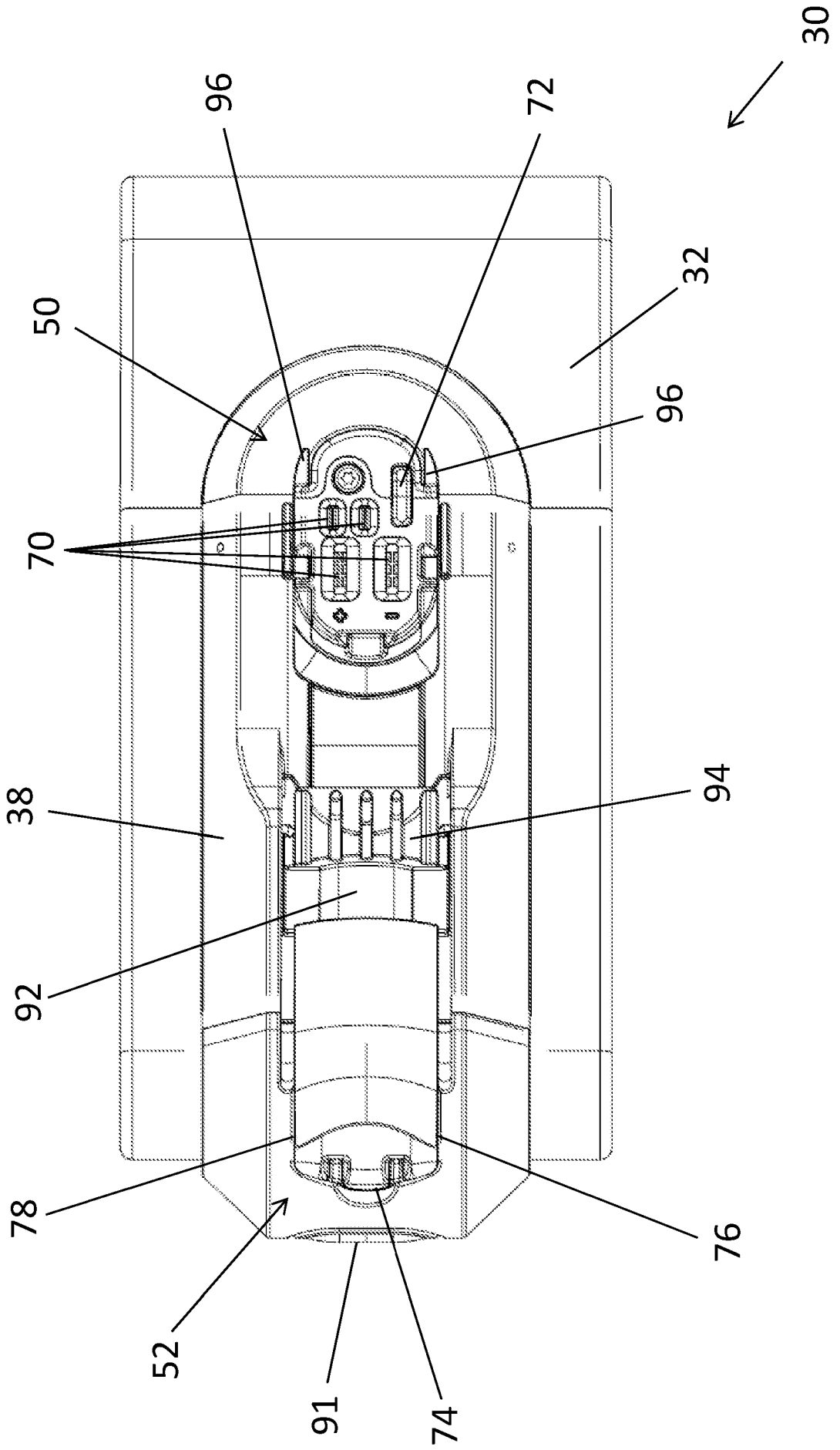


Fig. 4

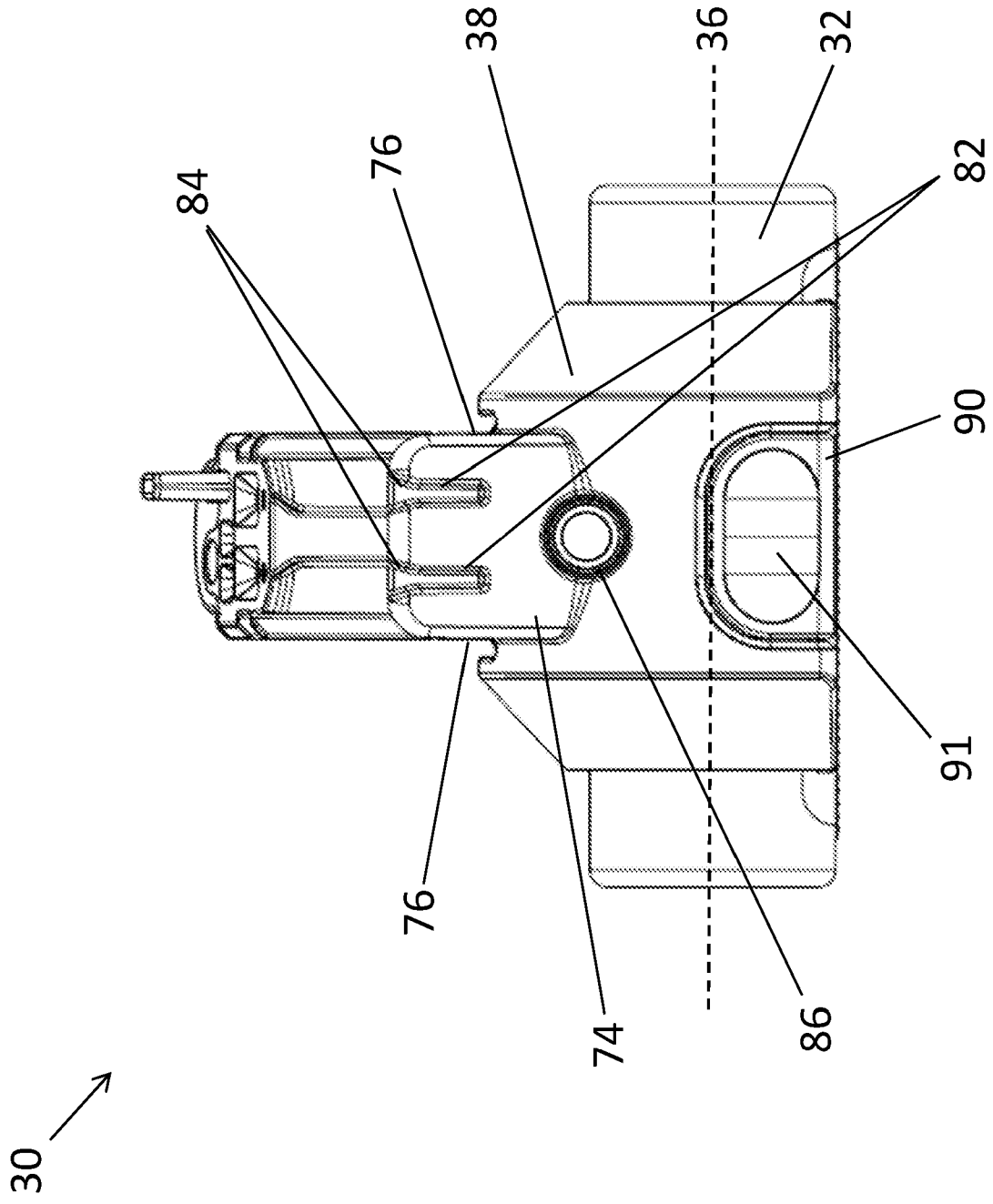


Fig. 5

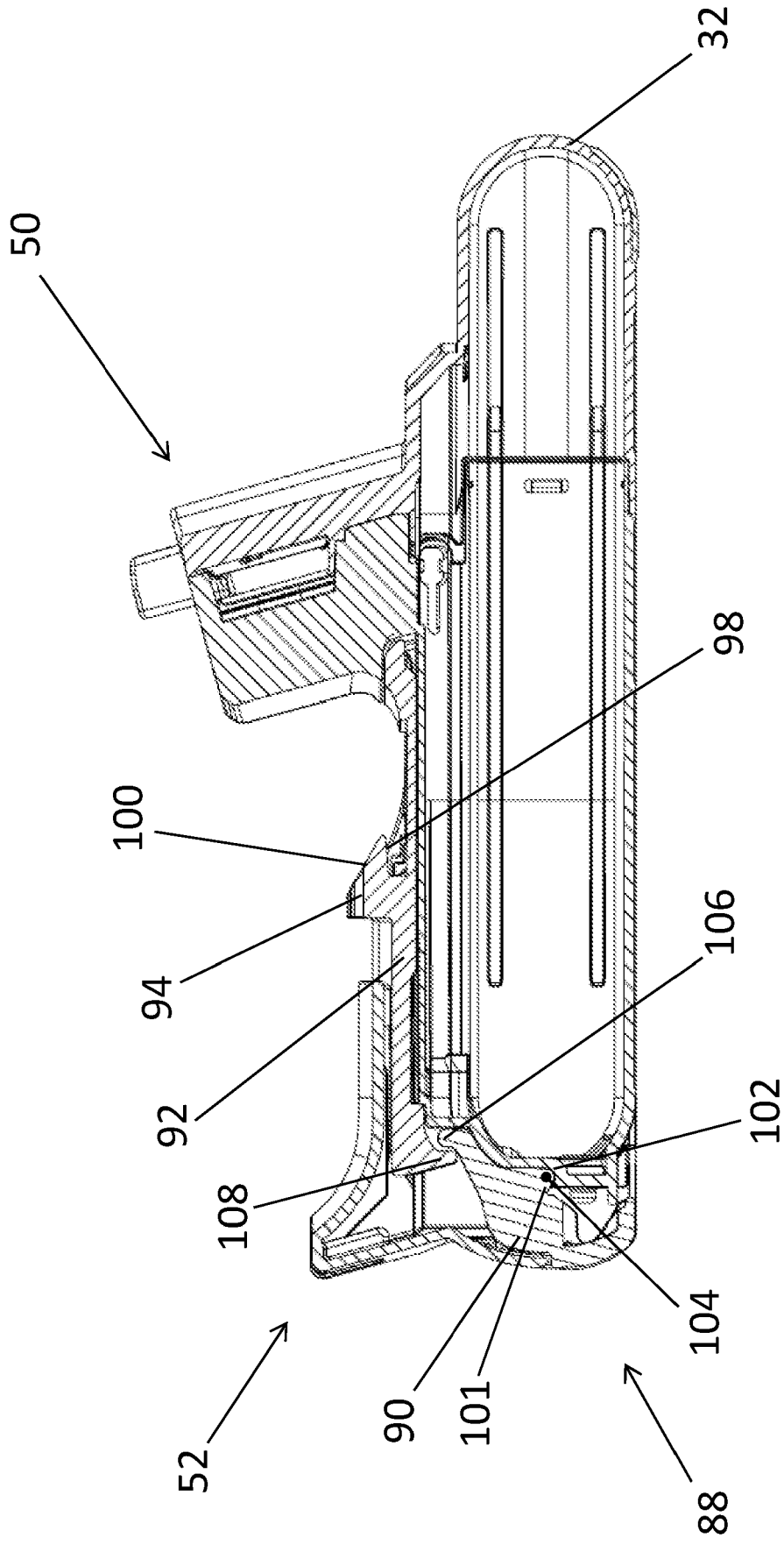


Fig. 6

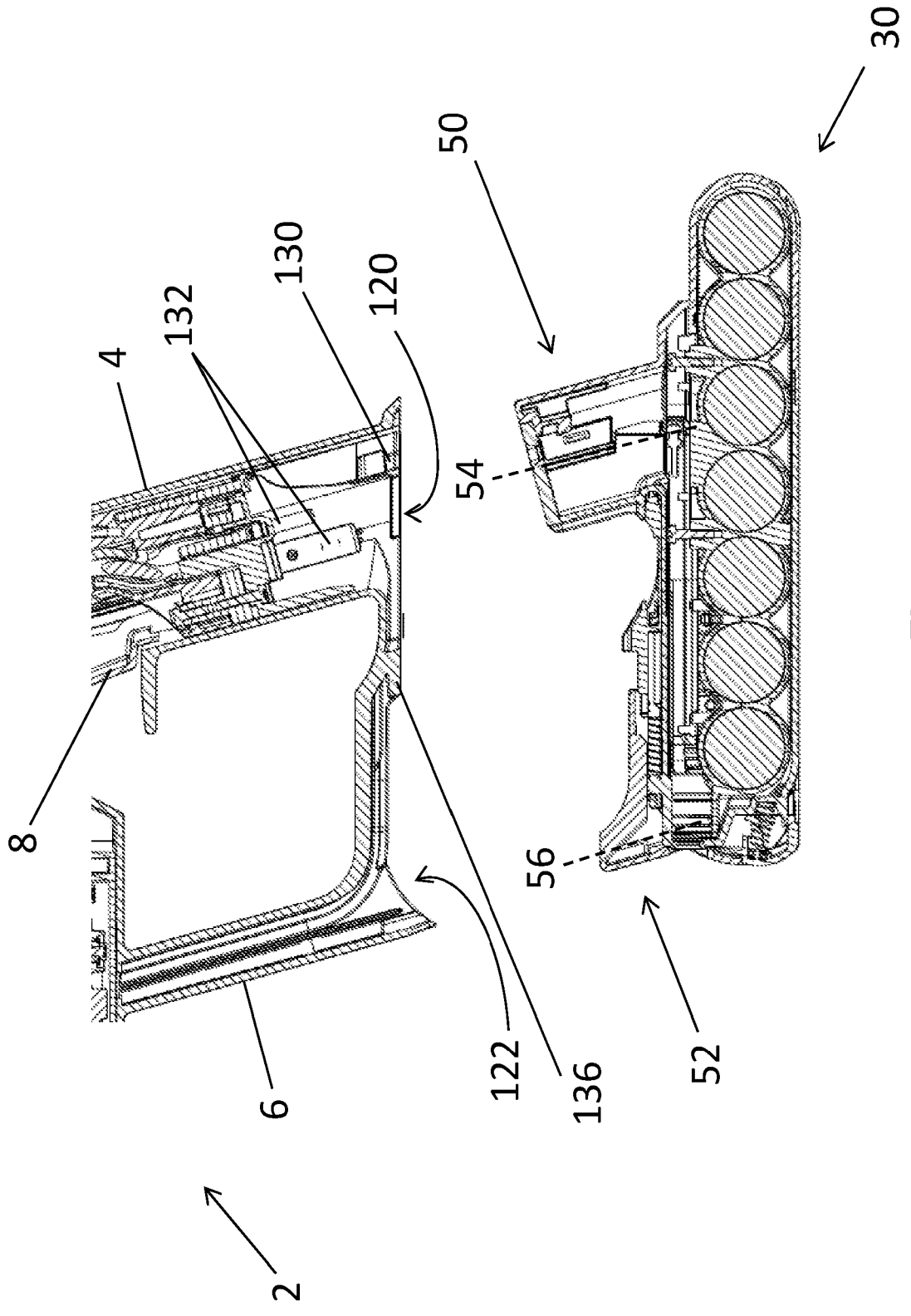


Fig. 7

Battery Pack for a Vacuum Cleaner

The present invention relates to the field of vacuum cleaners, in particular handheld vacuum cleaners and 'stick' vacuum cleaners of the general type comprising a handheld vacuum cleaner which is attached to a cleaner head by an elongate rigid wand.

Broadly speaking, there are four types of vacuum cleaner: 'upright' vacuum cleaners, 'cylinder' vacuum cleaners (also referred to as 'canister' vacuum cleaners), 'handheld' vacuum cleaners and 'stick' vacuum cleaners. Upright cleaners and cylinder cleaners are well known. They tend to be mains-operated and are used for relatively heavy-duty cleaning applications.

Handheld vacuum cleaners are relatively small, highly portable vacuum cleaners, suited particularly to relatively low duty applications such as spot cleaning floors and upholstery in the home, interior cleaning of cars and boats etc. Unlike upright cleaners and cylinder cleaners, they are designed to be carried in the hand during use, and tend to be powered by an on-board battery pack.

Broadly speaking, there are two distinct types of stick vacuum cleaner. The first type is, in a sense, an ultra slim-line upright cleaner, though usually battery powered rather than mains operated. The second type of stick-vac cleaner is a spin-off from the handheld vacuum cleaner, and comprises a handheld vacuum cleaner in combination with a rigid, elongate suction wand which effectively reaches down to the floor so that the user may remain standing while cleaning a floor surface. A floor tool is typically fixedly attached to the end of the rigid, elongate suction wand, or alternatively may be integrated with the bottom end of the wand.

The battery packs of vacuum cleaners (such as handheld and stick vacuum cleaners) are often removable, for instance to allow the battery to be replaced if it degrades, or to allow a user to swap between battery packs if they need to clean continuously for longer than the run-time of a single battery pack will allow. However, the ability to remove the battery pack often comes at the expense of the stability and/or strength of connection between the battery pack and the vacuum cleaner. For instance, in some cases the battery can 'wobble' significantly when attached to the vacuum cleaner, which can lead

to excessive wear (for instance at interfacing electrical contacts) or lead to an impression of lack of quality. Instead or as well, in some cases it can be difficult to correctly align the battery pack and the vacuum cleaner so as to attach them together, and attempting to attach the battery pack when it is misaligned can cause damage to the battery pack and/or the vacuum cleaner.

It is one object of the present invention to mitigate or obviate at least one of the above disadvantages, and/or to provide an improved or alternative battery pack or vacuum cleaner.

According to a first aspect of the present invention there is provided a battery pack for a vacuum cleaner, the battery pack comprising;

a plurality of cells arranged in a generally planar array;

a first projection extending along an axis which is generally normal to the plane of the array, the first projection comprising at least one electrical terminal;

a second projection extending along an axis which is generally parallel to the axis of the first projection,

wherein the second projection has an axial length at least 10% of the axial length of the first projection and comprises a rail or groove which extends generally parallel to the axis of the first projection.

The first and second projections may assist the user with attachment of the battery pack to the vacuum cleaner. For example, the first and second projections may be configured for receipt within respective recesses of the vacuum cleaner when the battery is attached thereto. The two projections can serve as alignment guides during attachment of the battery to the vacuum cleaner, whereas if a single projection were used then the user may be more free to attempt to attach the battery pack to the vacuum cleaner with the battery pack rotated slightly about the axis of the projection, which may cause frustration for the user and potentially damage to interfacing contacts on the battery pack and vacuum cleaner. Instead or as well, the first and second projections may provide structural support so that the interface between the battery pack and the vacuum cleaner is more solid. Two sets of interfacing projections and recesses can provide a greater area of contact between battery pack and vacuum cleaner, and can distribute the

engagement between battery pack and vacuum cleaner over more space so as to provide a more stable and secure interface.

5 The second projection having an axial length of at least 10% of the axial length of the first projection can increase the above effect(s), further increasing contact area, alignment function and/or stability of connection.

Said cells are provided in a substantially planar array.

10 The axes of the first and second projections are substantially parallel.

15 The first projection may intersect the plane of the array at an angle of no less than 65 degrees, for instance no less than 70 degrees. Instead or as well, the first projection may intersect the plane of the array at an angle of less than 90 degrees, for instance less than 85 degrees or less than 80 degrees. The first projection extending generally normal but at a slight angle to the plane of the array may provide an arrangement which is particularly suited to insertion of the first projection into a pistol grip of the vacuum cleaner while holding the battery pack so that the plane of the array is generally parallel to the palm, which may be an advantageously easy manoeuvre for a user to perform.

20 For the avoidance of doubt, the battery pack may have additional cells beyond those which form the generally planar array. For instance, the battery pack may comprise two generally planar arrays arranged on top of one another.

25 The battery pack is preferably rechargeable.

The axial length of the second projection may be at least 20%, for instance at least 30% or at least 40%, of the axial length of the first projection.

30 The second projection having such a relatively long axial length can increase the advantages discussed above.

The axial length of the second projection may be less than 80%, for instance less than 70% or less than 60%, of the axial length of the first projection.

In some circumstances increasing the length of the second projection can offer diminishing returns in terms of the advantages discussed above, and a second protrusion which is not excessively long can make the battery pack smaller, lighter and/or less unwieldy, and can avoid the second projection being too prone to bending.

Instead or as well, the second projections being noticeably shorter than the first projection can allow the first and second projections to be inserted into respective recesses of the vacuum cleaner sequentially, which may act to guide precise alignment of the battery pack during attachment to the vacuum cleaner, rather than requiring the user to align it perfectly at the start.

The battery pack may further comprise a charging port provided at least partially on the second projection.

Accommodating the charging port at least partially on the second projection can provide a space-efficient arrangement. In contrast, if the charging port (and associated wiring, etc) were provided elsewhere then the battery pack may have to be made larger, which in turn may make it heavier and/or more expensive.

The second projection may have a surface which extends substantially parallel to the axis of the first projection.

Such a surface can form a bearing surface which slides on a corresponding surface of the vacuum cleaner and functions to guide the movement of the battery pack along the axis of the first projection into place on the vacuum cleaner, and/or which provides a relatively large area of contact between the battery pack and the vacuum cleaner (thereby providing a stronger and/or more stable connection therebetween).

Said surface may face generally away from the first projection.

Said surface may be curved such that it is convex when viewed along the axis of the second projection.

The surface being curved in this way can allow slight rotational misalignment to be accommodated when attaching the battery pack to the vacuum cleaner.

Said surface may be generally arcuate when viewed along the axis of the second projection, the centre of the arc of the surface being located in the first projection. The surface may therefore accommodate slight misalignment in terms of rotation of the battery pack around the first projection. As an alternative, the surface may be generally arcuate and the centre of the arc may be between the first and second projections (thereby accommodating slight rotation of the battery pack about an axis between the projections) or the centre of the arc may be within the second projection (thereby accommodating slight rotation of the battery pack about the second projection).

The second projection comprises a rail or groove which extends generally parallel to the axis of the first projection.

Such a rail or groove can interlock with a complementary groove or rail in the vacuum cleaner, thereby providing a guiding function during insertion of the second projection into a recess in the vacuum cleaner, and/or providing a more solid connection between the projection and recess.

The battery pack may further comprise a selectively releasable latch mechanism for securing the battery pack to the vacuum cleaner.

The use of a selectively releasable latch mechanism can provide advantageously simple removal of the battery pack for the vacuum cleaner, for example for external charging or replacement. The latch mechanism being provided on the battery pack may allow for easier operation of the latch when holding the vacuum cleaner in one hand and the battery pack in the other, in comparison to arrangements where the latch was provided on the vacuum cleaner.

Optionally:

the latch mechanism comprises a latch member for engaging a complementary member of the vacuum cleaner so as to secure the battery pack, the latch member being movable between an engaging position and a releasing position;

the latch mechanism further comprises a manually-operable actuator which is movable between an engage position and a release position; and

the latch member and actuator are linked such that movement of the actuator from the engage position to the release position moves the latch member from the engaging position to the releasing position, but movement of the latch member from the
5 engaging position to the releasing position does not move the actuator from the engage position to the release position.

The user can therefore move the actuator to the release position so as to release the
10 latch member and detach the battery pack, but if the latch member is moved to the releasing position (for instance by a surface of the vacuum cleaner during insertion of the first projection into a recess) then the actuator does not move and therefore cannot confuse the user or trap their skin.

25 15 The latch mechanism may comprise at least two or at least three latch members configured to engage with respective complementary features in the vacuum cleaner.

The use of multiple latches provides multiple points at which the battery pack is secured to the vacuum cleaner. This, in turn, can mean a stronger connection. Also, the latch
20 members can be distributed about the battery pack, spreading the connection over a wider area and thereby making a more stable connection.

The battery pack may further comprise a button-operated switch arranged to control the supply of electricity to the electrical terminal, the button of the button-operated switch
25 being provided on the first projection.

The button may have line of action substantially parallel to axis of first projection.

30 According to a second aspect of the present invention there is provided a vacuum cleaner comprising a handle, a vacuum motor, a dirt separator and a battery pack according to the first aspect of the invention, the vacuum cleaner having a first recess for accommodating the first projection of the battery pack and a second recess for accommodating the second projection of the battery pack.

The second aspect of the invention can provide a vacuum cleaner with an advantageously strong or stable connection with the battery pack, and or one in which attachment of the battery pack is advantageously easy, for the reasons discussed above.

- 5 The vacuum cleaner is preferably a handheld vacuum cleaner or stick vacuum cleaner.

The handle may take the form of a pistol grip, and the first recess may be provided in the pistol grip.

- 10 This may provide an advantageously simple and/or compact arrangement.

Where the handle takes the form of a pistol grip and the battery pack comprises a button-operated switch, the pistol grip may comprise a trigger member positioned to be pulled by the finger of a user in a manner akin to the trigger of a pistol, the trigger member having an actuation member configured to operate the button-operated switch.

This may provide an advantageously comfortable and/or easily understood way of operating the vacuum cleaner.

- 20 The vacuum cleaner may have a front comprising a dirty air inlet, and the first and second recesses may be positioned generally in front of and behind one another.

The first and second recesses being so positioned means that both can be clearly visible if the user looks at the vacuum cleaner side-on. This can make it easier to line up the first and second projections of the battery pack with their respective recesses when attaching the battery, in contrast to an arrangement where only one of the recesses were visible in that orientation.

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

Figure 1 is a front perspective view of a vacuum cleaner according to an embodiment of the invention;

Figure 2 is a front perspective view of a battery pack of the vacuum cleaner of Figure 1;

Figure 3 is a cross sectional side view of the battery pack of Figure 2;

5 Figure 4 is a top view of the battery pack, viewed along an axis of a first projection thereof;

Figure 5 is front view of the battery pack;

10 Figure 6 is a further cross-sectional side view of the battery pack; and

Figure 7 is a cross-sectional side view of the battery pack and a lower portion of the vacuum cleaner.

15 Throughout the description and drawings, corresponding reference numerals denote corresponding features.

20 Figure 1 shows a vacuum cleaner 2 according to an embodiment of the invention. In this case the vacuum cleaner 2 is a handheld vacuum cleaner. It has a handle 4 in the form of a pistol grip, a front strut 6, a trigger 8 for turning the vacuum cleaner on and off, and an upper housing 10 which contains a vacuum motor (not visible) for drawing air through the vacuum cleaner 2. Air is drawn through the vacuum cleaner 2 from an inlet 12 at the front of the vacuum cleaner, which is configured to have a tool such as a cleaner head (or an elongate rigid suction wand, if the handheld vacuum cleaner 2 is to form part of a stick vacuum cleaner) attached to it. The air sucked in through the inlet 12 then passes through a primary cyclone 14 and secondary cyclones 16 of a cyclonic dirt separator 18, through the vacuum motor (not visible), then into a filter assembly 20 before being expelled through vents 22. The nature of these components of the vacuum cleaner 2 are not material to the present invention, therefore will not be described in detail.

30

The vacuum cleaner is powered by a battery pack 30 which is positioned below the pistol grip 4 and front strut 6. The battery pack 30 is shown in isolation in Figures 2 to 6. It has a base 32 which contains a set of cells 34. The cells 34 are arranged in a planar array, the plane 36 of which is horizontal in Figure 3. The battery pack 30 also has a raised

area 38 adjacent to the base 32, which houses a battery control circuit 40. Extending from the raised area 38, and therefore indirectly from the base 32, are a first projection 50 and a second projection 52 which extend along respective axes 54, 56.

- 5 The axis 54 of the first projection 50 is generally normal to the plane 36 of the array of cells 34. More particularly, in this case the axis 54 intersects the plane 36 at an angle of around 75 degrees. The second projection 52 extends along an axis 56 which is generally parallel, in this case exactly parallel, to the axis 54 of the first projection 50. The axial length 58 of the second projection 52 is at least 10% of the axial length 60 of the first projection 50. More particularly, in this case the axial length 58 of the second projection 52 is around 50% of the axial length 60 of the first projection 50.

The first projection 50 comprises a set of electrical contacts in the form of sockets 70 through which power from the cells 34 can be supplied to the vacuum cleaner 2 (in particular the vacuum motor) or through which control signals or other information can be passed. The first projection 50 further comprises a button-operated switch (not visible), the button 72 of which projects from the distal end of the first projection. The button 72 has a line of action which is parallel to the axis 54 of the first projection. In other words, when the button 72 is pressed it moves in a direction parallel to the axis 54.

The second projection 52 has a front surface 74 which faces generally away from the first projection 50, left and right side surfaces 76, 78, and a rear surface 80 which faces generally towards the first projection 50. As discussed later the front and side surfaces 74, 76, 78 each run parallel to the axis of the first projection. The side surfaces 76, 78 are flat, and the front surface 74 is convex when viewed along the axis 56 of the second projection 52 and flat when viewed from the side, and. More particularly, the front surface 74 is generally arcuate when viewed along the axis 56 of the second projection 52, and the centre of that arc is located in between the first and second projections. The rear surface 80 is convex when viewed along the axis of the second projection and concave when viewed from the side.

The front surface 74 has a pair of grooves 82 each of which extends parallel to the axis 54 of the first projection 50 and has a flared mouth 84. The front surface 74 also accommodates the upper half of a charging port 86 which in this case takes the form of

a socket for accommodating a charging plug (not shown). The lower half of the charging port 86 is accommodated in the front of the raised area 38, allowing for easy connection between the charging port 86 and the battery control circuit.

5 The battery pack 30 has a latch mechanism 88 for securing the battery pack to the vacuum cleaner 2. The latch mechanism 88 comprises a manually-operable actuator 90 on which a button 91 is provided, and a carriage 92 on which a front latch member 94 and two side latch members 96 are provided. Each of the latch members 94, 96 is configured to engage a complementary member (not shown) of the vacuum cleaner so
10 as to secure the battery pack. In this case each latch member 94, 96 has a lower contact surface 98 and an upper cam surface 100, the function of which will be described below.

The actuator 90 has a lobe 101 which is rotatably received in a dished socket 102 at the front of the base 32 so as to define a pivot axis 104. The actuator 90 also has a further
15 lobe 106 which is positioned to engage a hook 108 provided on the front of the carriage 92. The actuator 90 is movable, in this case pivotable about pivot axis 104, between an engage position (as shown in the figures) and a release position in which it is pivoted rearwardly. In this embodiment the actuator 90 is biased to the engage position by a coil spring 110 (visible in Figure 3).

20 The latch members 94, 96 are movable, in this case by sliding the carriage horizontally, between an engaging position (as shown in the figures) and a releasing position in which they are located further forwards. The carriage is biased rearwards by a coil spring (not shown) so as to bias the latch members to the engaging position.

25 The hook 108 of the carriage 92 and the lobe 106 of the actuator 90 link the latch members 94, 96 and the actuator 90 such that such that movement of the actuator 90 from the engage position to the release position moves the latch members 94, 96 from the engaging position to the releasing position, but moving the latch members 94, 96
30 from the engaging position to the releasing position does not move the actuator 90 from the engage position to the release position. If the actuator 90 is pivoted rearwardly to move it to the release position, the lobe 106 bears on the hook 108 of the carriage 92, forcing it forwards and thereby moving the latch members 94, 96 to the releasing position. However, if the latch members are pushed forwards to the releasing position

then the hook 108 becomes spaced apart from the lobe 106, and the actuator 90 can remain in the engage position under the influence of the coil spring 110.

Figure 7 shows the battery pack 30 aligned for attachment to the vacuum cleaner 2. The vacuum cleaner 2 has a first recess 120 for accommodating the first projection 50 of the battery pack 30, and a second recess 122 for accommodating the second projection 52. The first recess 120 is provided in the lower half of the pistol grip 4, and the second recess 122 is provided in the bottom of the front strut 6. The first and second recesses 120, 122 are therefore positioned in front of and behind one another, in this case with the second recess 122 positioned in front of the first recess 120.

The first recess 120 has a pair of ledges 130 at the lower rear ends on both sides, and a set of electrical contacts in the form of descending pins 132 for receipt within the sockets 70 of the first projection 50 so as to electrically connect the vacuum cleaner and battery pack. The second recess 122 has a window cut-out 134 positioned to align with the charging port 86, and a pair of rails 138 positioned to be received within the grooves 82 in the front surface 74 of the second projection 52. Positioned between the pistol grip 4 and front strut 6 is a further ledge 136. The ledges 130, 136 are the complementary features engaged by the latch members 94, 96 as discussed below.

To attach the battery pack 30 to the vacuum cleaner 2, the battery pack is positioned beneath the pistol grip 4 and front strut 6 such that the first and second projections 50, 52 are aligned with their respective recesses 120, 122, as shown in Figure 7. The battery pack 30 is then moved generally upward along the axis 54 of the first projection 50 (and indeed the axis 56 of the second projection 52) so as to insert the distal end of the first projection 50 into the bottom of the first recess 120. Further movement of the battery in this direction inserts the first projection 50 deeper into the first recess 120, and inserts the distal end of the second projection 52 into the bottom of the second recess 122. As the second projection 52 enters the second recess 122, the rails 138 enter the grooves 82 through their mouths 84.

At this point, both projections 50, 52 are received part way into their respective recesses 120, 122. With these two spaced-apart points of contact between the battery pack 30 and vacuum cleaner 2, it becomes very difficult to misalign the battery and vacuum

cleaner. Such misalignment could otherwise lead to excessive wear, or even damage to the pins 132 by attempting to insert them into the sockets 70 when out of alignment.

In particular, as the battery pack 30 is moved further along the axis 54 of the first projection 50, the front surface 74 and side surfaces 76, 78 of the second projection 52 bear on corresponding surfaces on the inside of the second recess 122. Due to these surfaces being parallel to the axis 54 of the first projection, they will continue to provide support and stability while the battery continues to be moved into place. Equally, the rails 138 slide along the grooves 82 and provide further stability and support.

Further movement of the battery pack 30 along the axis 54 of the first projection 50 causes the pins 132 to enter the sockets, electrically connecting the battery pack 30 and vacuum cleaner. As the battery pack 30 approaches its final position, the undersides of the ledges 130 in the first recess 122 bear against the cam surfaces 100 of the side latch members 96 and the underside of ledge 136 bears on the cam surface 100 of the front latch member 94. The latch members 94, 96, and thus the carriage 92, are therefore urged forwards and the latch members approach the released position.

When the battery pack 30 reaches its final position, the latch members 94, 96 reach the tops of their respective ledges 130, 136 whereupon they are free to travel rearwards again to the engaged position (due to the spring urging the carriage 92 rearwards). The contact surfaces 98 of the latch members then rest on top of their respective ledges 130, 136 securing the battery pack 30 so that it cannot be moved away from the vacuum cleaner. With the battery pack 30 secured in place, the button 72 is positioned beneath an actuation member (not visible) mounted to the trigger 8. When the trigger 8 is pulled by a user's finger, in a manner akin to pulling the trigger of a pistol, the actuation member (not visible) depresses the button 72 and thereby operates the button-actuated switch (not visible). This signals the battery control circuit 40 to supply power from the cells 34 to the sockets 70 so as to make it available to the vacuum motor (not visible).

To detach the battery pack 30 from the vacuum cleaner 2, the user presses the button 91 of the actuator so as to pivot it rearwards to the release position. This moves the latch members 94, 96 forwards to the releasing position, as discussed above, unhooking them

from the ledges 130, 136 and thereby allowing the battery pack 30 to be removed by moving it away from the vacuum cleaner along the axis 54 of the first projection 50.

5 It will be appreciated that numerous modifications to the above described embodiment may be made without departing from the scope of invention as defined in the appended claims. For instance, the axis of the second projection need not be exactly parallel to that of the first projection. This may reduce the support offered by the second projection during attachment of the battery pack, but the second projection may nonetheless provide an advantageously strong or stable connection when the battery pack is attached
10 to the vacuum cleaner.

For the avoidance of doubt, the optional and/or preferred features described above may be utilised in any suitable combinations, and in particular in the combinations set out in the appended claims. Features described in relation to one aspect of the invention, may
15 also be applied to another aspect of the invention, where appropriate.

CLAIMS

1. A battery pack for a vacuum cleaner, the battery pack comprising;
a plurality of cells arranged in a generally planar array;
5 a first projection extending along an axis which is generally normal to the plane
of the array, the first projection comprising at least one electrical terminal;
a second projection extending along an axis which is generally parallel to the axis
of the first projection,
wherein the second projection has an axial length at least 10% of the axial length
10 of the first projection and comprises a rail or groove which extends generally parallel to
the axis of the first projection.

2. A battery pack according to claim 1 wherein the axial length of the second projection
is at least 30% of the axial length of the first projection.

3. A battery pack according to claim 1 or 2 wherein the axial length of the second
projection is less than 70% of the axial length of the first projection.

4. A battery pack according to any preceding claim further comprising a charging port
20 provided at least partially on the second projection.

5. A battery pack according to any preceding claim wherein the second projection has a
surface which extends substantially parallel to the axis of the first projection.

6. A battery pack according to claim 5 wherein said surface is curved such that it is
convex when viewed along the axis of the second projection.

7. A battery pack according to any preceding claim further comprising a selectively
releasable latch mechanism for securing the battery pack to the vacuum cleaner.

8. A battery pack according to claim 7 wherein:

the latch mechanism comprises a latch member for engaging a complementary member of the vacuum cleaner so as to secure the battery pack, the latch member being movable between an engaging position and a releasing position;

5 the latch mechanism further comprises a manually-operable actuator which is movable between an engage position and a release position; and

10 the latch member and actuator are linked such that movement of the actuator from the engage position to the release position moves the latch member from the engaging position to the releasing position, but movement of the latch member from the engaging position to the releasing position does not move the actuator from the engage position to the release position.

15 9. A battery pack according to claim 7 or 8 wherein the latch mechanism comprises at least three latch members configured to engage with respective complementary features in the vacuum cleaner.

20 10. A battery pack according to any preceding claim further comprises a button-operated switch arranged to control the supply of electricity to the electrical terminal, the button of the button-operated switch being provided on the first projection.

25 11. A vacuum cleaner comprising a handle, a vacuum motor, a dirt separator and a battery pack according to any preceding claim, the vacuum cleaner having a first recess for accommodating the first projection of the battery pack and a second recess for accommodating the second projection of the battery pack.

12. A vacuum cleaner according to claim 11 wherein the handle takes the form of a pistol grip, and the first recess is provided in the pistol grip.

30 13. A vacuum cleaner according to claim 12, incorporating claim 10, wherein the pistol grip comprises a trigger member positioned to be pulled by the finger of a user in a manner akin to the trigger of a pistol, the trigger member having an actuation member configured to operate the button-operated switch.

14. A vacuum cleaner according to any one of claims 11 to 13, wherein the vacuum cleaner has a front comprising a dirty air inlet, and the first and second recesses are positioned generally in front of and behind one another.