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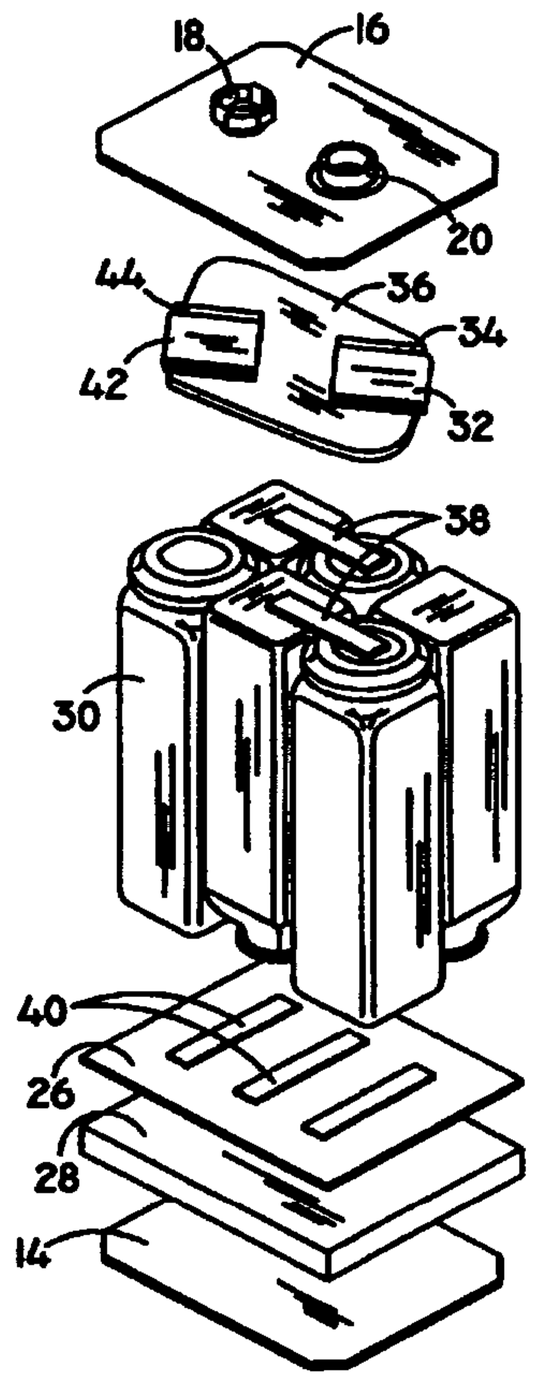
(54) **CELLULE ELECTROCHIMIQUE PRISMATIQUE ET BATTERIE MULTICELLULAIRE**

(54) **PRISMATIC ELECTROCHEMICAL CELL AND MULTICELL BATTERY**



(57) L'invention concerne une batterie comprenant un groupe de cellules rectangulaires, pourvues d'extrémités cylindriques et logées dans un contenant de batterie rectangulaire, ainsi qu'une batterie comprenant une seule cellule électrochimique rectangulaire dotée d'une extrémité cylindrique. Chaque cellule présente une section rectangulaire logeant sensiblement les matériaux actifs de la cellule, ainsi qu'une extrémité cylindrique pourvue d'un ensemble couvercle/scellement rond assemblé à cette cellule.

(57) A battery having an array of rectangular cells with cylindrical ends housed in a rectangular battery container and a battery having a single rectangular electrochemical cell with a cylindrical end. Each cell has a rectangular section substantially housing the active cell materials and a cylindrical end with a round cover/seal assembly assembled thereto.

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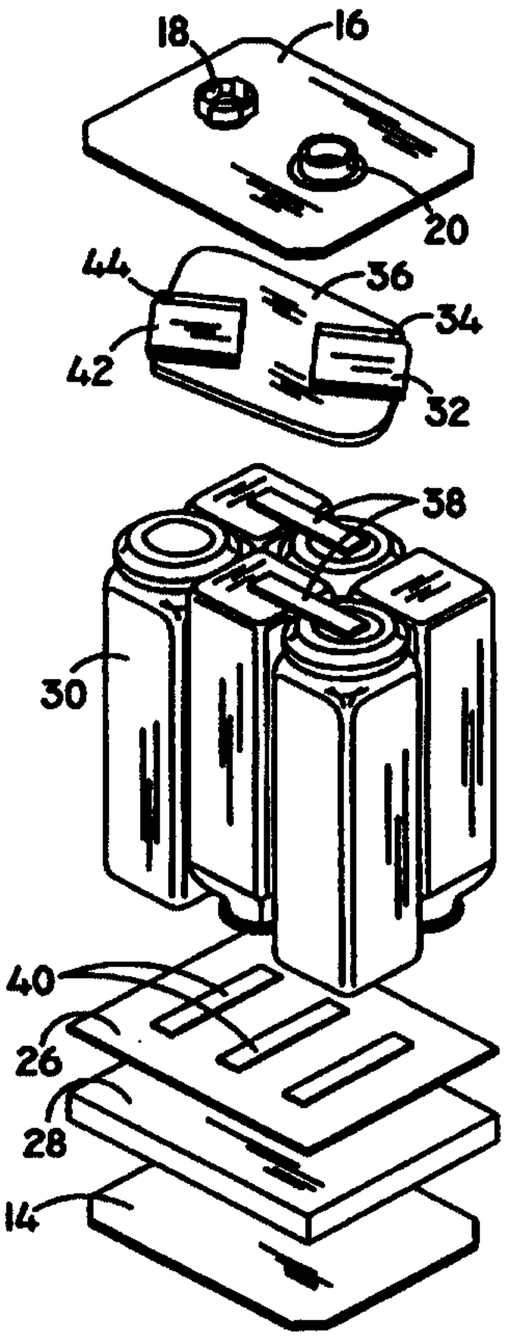
(57) Abstract

A battery having an array of rectangular cells with cylindrical ends housed in a rectangular battery container and a battery having a single rectangular electrochemical cell with a cylindrical end. Each cell has a rectangular section substantially housing the active cell materials and a cylindrical end with a round cover/seal assembly assembled thereto.



PRISMATIC ELECTROCHEMICAL CELL AND MULTICELL BATTERY

BACKGROUND OF THE INVENTION

The present invention generally relates to an electrochemical cell and battery and, more particularly, to an electrochemical cell and an assembly of multiple cells in a rectangularly housed battery.

Conventional alkaline batteries commonly employ cylindrical cells, each generally having a cylindrically shaped steel can provided with a positive cover at one end and a negative cover at the opposite end. The cylindrical cell often includes a cathode preferably formed of a mixture of manganese dioxide, graphite, potassium hydroxide solution, deionized water, and a TEFLON® solution, formed about the interior side surface of the cylindrical steel can. A cup-shaped separator is usually disposed about the interior surface of the cathode. An anode, typically formed of zinc powder, a gelling agent, and other additives, is dispensed with electrolyte solution within the separator.

Standard alkaline cells are commercially available for providing an open circuit voltage of about 1.5 volts. When a higher voltage is required, it is common practice to combine multiple cells to form a battery having the required voltage. In so doing, a plurality of cells are commonly housed in a container and connected in series, with external terminals attached to the container and making contact with the series connected cells. In particular, the standard rectangular-housed, 9-volt battery, which is commonly used in smoke detectors and portable electronic devices, includes six, 1.5-volt cells connected in series. One example of a rectangular battery employs two stacks of three cylindrical cells disposed parallel to each other as is disclosed

in U.S. Patent No. 4,959,280 entitled "Battery Assembly," which is hereby incorporated by reference. It is also known to employ six, 1.5-volt cylindrical cells arranged in parallel with each other in a 2 x 3 array. However, the use of multiple, parallel disposed cylindrical cells housed within a rectangular container results in unused space between adjacent cells, as well as between each cell and the inside wall of the battery container.

A primary goal in designing alkaline batteries is to increase the service performance of the cell. The service performance is the length of time for the cell to discharge under a given load to a specific voltage at which the cell is no longer useful for its intended purpose. Commercially available alkaline cells and batteries commonly have an external size that is defined by industry standards, thereby limiting the ability to increase the amount of active materials within a given cell and confining the volume available in a multiple cell battery. However, conventional batteries often do not optimize volume consumption within the housing of the battery. Accordingly, the need to find new ways to increase service performance remains the primary goal of the cell and battery designers.

SUMMARY OF THE INVENTION

The present invention improves the performance of a cell and a rectangularly housed, multiple cell battery by providing the cell with a prismatic can, preferably of a rectangular configuration, having a cylindrical end. To achieve this and other advantages, and in accordance with the purpose of the invention as embodied and described herein, the present invention provides an electrical cell configured having a prismatic section, such as a rectangular section, and a cylindrical end. The rectangular prismatic section has a substantially prismatic radial cross

section and houses the active materials of the cell including a cathode and an anode, as well as a separator. The anode is preferably provided in an inner cylindrical volume of the cell. The cell may be assembled with a round cover and seal assembly provided on the cylindrical end.

The present invention also provides a plurality of prismatic cells, such as rectangular cells, assembled in a rectangular housing of a multiple cell battery. The cells are each configured with a rectangular section to allow multiple cells to be assembled close together and thereby optimize volume consumption within the battery housing.

These and other features, objects, and benefits of the invention will be recognized by those who practice the invention and by those skilled in the art, from reading the following specification and claims, together with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

In the drawings:

FIG. 1 is a partial perspective view of a rectangular battery having six rectangular electrochemical cells with cylindrical ends assembled according to the present invention;

FIG. 2 is a top plan view of the battery of FIG. 1 showing the cells assembled in the battery housing;

FIG. 3 is a partial exploded view of the battery of FIG. 1;

FIG. 4 is an elevational view of one rectangular electrochemical cell with a cylindrical end according to the present invention;

FIG. 5 is a top view of the electrochemical cell shown in FIG. 4;

FIG. 6 is a cross-sectional view of the electrochemical cell taken through lines VI-VI in FIG. 5;

FIG. 7 is a cross-sectional view of the electrochemical cell taken through lines VII-VII in FIG. 4; and

FIG. 8 is a cross-sectional view of the electrochemical cell taken through lines VIII-VIII of FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, a multiple cell battery 10 is shown having a rectangular housing 12, preferably including a metal jacket, with a non-conductive coating, defining four sidewalls and top and bottom terminal boards 14 and 16 defining the respective top and bottom surfaces. The battery 10 has positive and negative contact terminals 18 and 20 assembled to the top terminal board 16 via rivets (not shown). According to the embodiment shown and described herein, the size and shape of the housing 12, as well the location of the positive and negative contact terminals 18 and 20, is provided in accordance with the standard commercially available 9-volt rectangular battery according to current industry standards. Nine-volt rectangularly housed batteries of this size and shape are widely available, particularly for use with smoke detectors and portable electronic devices.

While a rectangular configured cell and a rectangular battery housing multiple rectangular cells are shown and described herein according to the preferred embodiment, it should be appreciated that the teachings of the present invention are not limited to the embodiments shown. The teachings of the invention may be applicable to various multiple cell battery housings and

various electrochemical cell configurations having a generally prismatic shape. Additionally, the present invention is not limited to the alkaline cell having manganese dioxide/zinc, as various other cells may be used, such as carbon/zinc, nickel/hydride, nickel/cadmium, nickel/zinc, lithium/carbon/zinc, as well as other electrochemical cells.

According to the preferred embodiment, the battery 10 houses a plurality of rectangular cells 30 having cylindrical ends according to the present invention. The rectangular cells 30 are advantageously assembled parallel to each other in a compact relationship such that adjacent cell walls are close together and preferably abut each other and the remaining cell walls closely abut the interior sides of the housing so as to fit compactly within battery housing 12. This maximizes volume consumption of housing 12 which allows for realization of increased performance achievable for a given size battery housing. Accordingly, the series connected cells 30 substantially consume the internal volume of housing 12 so as to fully utilize the space available in a standard size battery housing.

Referring particularly to FIG. 2, the assembly of cells 30 within housing 12 are seen from a top view with the top terminal board 16 and top cover assembly removed. The six cells 30 are assembled in a 3 x 2 array and substantially consume the available volume within rectangular housing 12 of battery 10. The six cells 30 are arranged within housing 12 in an alternating fashion such that the positive and negative terminal ends of cells 30 are flip-flopped relative to adjacent cells. The cells 30 are electrically interconnected in series such that battery 12 provides a battery supply voltage across terminals 18 and 20 equal to the total aggregate voltage supply of the cells 30. According to one example, each of the six cells 30 supplies an approximate 1.5 volts, thereby providing an approximate 9-volt battery voltage supply.

With particular reference to FIG. 3, the battery 10 and assembly thereof is shown in an exploded view with the metal jacket walls of housing 12 removed. Cells 30 are disposed in contact with bottom conductive contact strips 40 on the bottom side and top conductive contact strips 38 on the top side, which provide a series interconnection of battery cells 30. Contact strips 40 are assembled on a thin insulating paper 26 which, in turn, is disposed on the top surface of a resilient pad 28. Resilient pad 28 lies on top of the bottom terminal board 14 of battery 10. Resilient pad 28 preferably includes a rubber material which provides a spring-like surface. When compressed, resilient pad 28 forcibly urges contact strips 40 against the corresponding terminals on the cells 30 on the bottom side, while also forcibly urging the upper terminals of cells 30 against contact strips 38 on the top side. This pressure contact ensures a continuous series interconnection of cells 30. Although the conductive contact strips provide pressure contact for the cells, it should be appreciated that one or more of the contact strips could be soldered or welded to the cells using conventional methods.

Contact strips 38 similarly are assembled to contact the corresponding terminals on the top side of cells 30. Contact strips 38 are disposed below a support pad 36, which may include cardboard. Disposed about opposite corners of support pad 36 are metal contact pads 32 and 42, which wrap around the top and bottom sides of support pad 36. Contact pads 32 and 42 are assembled on top of thin layers of insulating paper 34 and 44, respectively. Metal contact pad 32 directly contacts both the positive terminal of one cell 30 and the positive contact terminal 20 of battery 10. Metal conductive pad 42 directly contacts both the negative terminal of another cell 30 and the negative contact terminal 18 of battery 10. The two cells 30 in contact with contact pads 32 and 42 are at opposite ends of the series electrical interconnection. Accordingly, positive

and negative contact terminals 20 and 18, respectively, provide a voltage potential across the series electrical interconnection of cells 30.

Referring to FIG. 4, one of the electrochemical cells 30 is shown configured with a rectangular steel can 60 having a cylindrical end according to the present invention. Steel can 60 has a rectangular section 50 extending along a vast majority of the length of the cell, and a cylindrical section 52 provided near the top end. The rectangular section 50 of cell 30 is substantially rectangular with rounded corners and transitions to the cylindrical section 52 via a bottleneck section 54. The cylindrical section 52 allows a round cover and seal assembly 56 to be easily welded or otherwise assembled to the top end.

The cell 30 has a bottom end 58 defined by the bottom side of the rectangular section 50. The bottom end 58 serves as a positive cover to provide a positive cell terminal. At the top end of the cylindrical section 52 is seal assembly 56 with a substantially rounded shape which includes a negative cell cover or terminal 62. The top end of cell 30 is further shown in FIG. 5.

According to the configuration shown, cell 30 realizes increased volume in the rectangular section 50 in contrast to the conventional cylindrical cell used in a rectangular battery, while having a cylindrical end 52 that easily accommodates the standard round negative cover and seal assembly 56. This allows for an increase in active cell materials over that of the conventional cylindrical cell of a size having a diameter equal to the width of the side walls of the cylindrical section 52.

Referring to FIGS. 6 and 8, the electrochemical cell 30 is further illustrated in cross-sectional views taken along the longitudinal axis of the cell 30 and at an angular displacement of forty-five degrees relative to the two views. The cell 30 includes steel can 60 having a

rectangular shape with a bottom end 58 forming a positive terminal and having a seal assembly 56 with outer negative cover 62 assembled on the top end of the cell 30. A thin layer of shrink tube insulation 72 covers the sides of steel can 60 to electrically insulate the metal casing of the cell from adjacent cells and also from the housing 12 of battery 10. A cathode 64, preferably formed of a mixture of manganese dioxide, graphite, potassium hydroxide solution, deionized water, and a TEFLON® solution is formed about the interior side surface of steel can 60. A cup-shaped separator 66, which is preferably formed of a non-woven fabric that prevents migration of any solid particles in the battery, is disposed about the interior surface of cathode 64. An anode 68, such as a gelled anode, is injected into or otherwise disposed within the interior of the cup-shaped separator 66. Disposed within anode 68 is a current collector 70 in contact with zinc concentration in anode 68. The current collector 70 provides a negative contact to the negative cell terminal 62.

The seal assembly 56 provides a closure to the assembly of cell 30 and includes a seal body 76 and compression means 74. The seal body 76 is generally shaped like a disk and made from electrically non-conductive material. The compression element 76 is a tubular-shaped metallic component that compresses the seal body 76 around the current collector 70. The seal assembly 56 also includes the outer negative cover 62 welded to the exposed end of the current collector 70 to form the cell's negative terminal. The rim of steel can 60 is crimped inwardly toward the cell body to form a hermetic seal. The seal assembly 56 with cover 62 may include a conventional round assembly, such as that disclosed in U.S. Patent No. 5,422,201, which is hereby incorporated by reference.

The rectangular section 50 of cell 30 has a substantially square cross section with rounded corners and equal width *W* side walls, as shown in FIG. 7. The active materials of cell 30, including the anode 68 and cathode 64, are substantially disposed within the rectangular section 50. By providing a rectangular configuration, the volume within the rectangular section 50 of cell 30 is larger than that of a conventional cylindrical cell having dimensions that would fit within the rectangular walls of cell 30. This allows for an increase in the volume of the cathode 64 as well as the anode 68. In addition, the cup-shaped separator 66 may be further disposed radially outward from the longitudinal axis of cell 30 so as to provide a greater anode-to-cathode interface surface area separating the anode 68 and cathode 64 from each other. It should be appreciated that the additional active materials, including those disposed within the corners of the cathode 64, discharge to increase the capacity of cell 30.

According to one example, a cell 30 having a square cross section can experience a gain in service performance by as much as approximately 25 percent over the performance experienced with a cylindrical cell having a diameter equal to the cross-sectional width *W* of the side walls of the rectangular section. The rectangular configuration of cell 30 according to the present invention allows for approximately 21 to 25 percent more active materials to be used and allows for an approximate 12 percent increase in anode-to-cathode interface surface area. Cathode-to-can contact resistance is a significant factor in high current discharge of conventional cylindrical cells. With the square cross section cell 30 of the present invention, the cell 30 may achieve up to a 27 percent lower contact resistance because the can-to-cathode contact area is increased up to 27 percent.

The cell 30 can be assembled by starting with a cylindrical steel can having a closed bottom end and an open top end. According to this embodiment, the initial cylindrical can may be reshaped in a rectangular configured mold to form the rectangular section 50. According to one approach, the materials of cathode 64 are dispensed within the cylindrical can and the can is disposed within the rectangular configured mold. A ramrod, which sealingly engages the can with a stripper ring, can be forcibly injected into the can to form a cylindrical passage for the separator and anode, while at the same time forcing the cylindrical can to be reshaped into a rectangular section as defined by the surrounding mold. Once this is achieved, the ramrod can be removed and the separator 66 and anode 68 disposed in the cylindrical opening. Thereafter, the collector 70 is inserted into place and the seal assembly 56 with outer negative cover 62 is assembled to the can. Alternatively, the assembly of cell 30 could include reshaping a rectangular can to include a cylindrical end. It should also be appreciated that the housing 50 of cell 30 could otherwise be manufactured in a mold to include both the rectangular and cylindrical sections.

While cell 30 is shown and described with its preferred embodiment having a rectangular section with a square cross section, it should be appreciated that a rectangular cross section with unequal sides or other prismatic section may be employed without departing from the teachings of the present invention. In addition, it should be appreciated that an electrochemical cell with a prismatic housing having a cylindrical end can be used as a component of a single cell battery or a multiple cell battery, without departing from the spirit and scope of the present invention.

It will be understood by those who practice the invention and those skilled in the art, that various modifications and improvements may be made to the invention without departing from

the spirit of the disclosed concept. The scope of protection afforded is to be determined by the claims and by the breadth of interpretation allowed by law.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A multiple cell battery comprising:

a battery housing;

a positive contact terminal;

a negative contact terminal; and

a plurality of electrochemical cells assembled in said battery housing and in electrical contact with said positive and negative contact terminals, each of said plurality of cells having a prismatic section with a substantially prismatic, radial cross section and housing active cell materials, and each of said cells further having a cylindrical end with a seal assembly assembled to said cylindrical end.

2. The battery as defined in claim 1, wherein said substantially prismatic, radial cross section comprises a substantially rectangular section.

3. The battery as defined in claim 2, wherein said battery housing comprises a rectangular housing.

4. The battery as defined in claim 2, wherein said rectangular section has a substantially square cross section.

5. The battery as defined in claim 1, wherein said prismatic section of each of said plurality of cells substantially houses a cathode and an anode, and wherein said anode is disposed within a cylindrical volume of said prismatic section.

6. The battery as defined in claim 1, wherein said plurality of cells are electrically connected in series.

7. The battery as defined in claim 1, wherein said cover comprises a round cover.

8. The battery as defined in claim 1, wherein said battery further comprises pressure contact strips electrically connecting said plurality of cells.

9. A multiple cell battery comprising:

a battery housing;

a positive contact terminal;

a negative contact terminal; and

a plurality of electrochemical cells assembled in said housing and in electrical contact with said positive and negative contact terminals, each of said plurality of cells having a prismatic section with a substantially prismatic, radial cross section and housing a cathode and an anode, wherein said anode is disposed within an inner cylindrical volume of said prismatic section.

10. The battery as defined in claim 9, wherein said substantially prismatic radial cross section comprises a substantially rectangular section.

11. The battery as defined in claim 10, wherein said battery housing comprises a rectangular housing.

12. The battery as defined in claim 10, wherein said rectangular section has a substantially square cross section.

13. The battery as defined in claim 9, wherein each of said plurality of cells further comprises a cylindrical end and a cover assembled to said cylindrical end.

14. The battery as defined in claim 9, wherein said plurality of cells are electrically connected in series.

15. An electrochemical cell comprising:

a container having a substantially prismatic section with a substantially prismatic radial cross section and a closed bottom end, said container further having a cylindrical section with a round top end;

a cathode housed substantially within said prismatic section;

an anode disposed substantially within said prismatic section;

a separator disposed between said anode and said cathode; and

a cover assembled to said round top end.

16. The electrochemical cell as defined in claim 15, wherein said anode is disposed within a substantially cylindrical volume of said prismatic section.

17. The electrochemical cell as defined in claim 15, wherein said substantially prismatic section comprises a substantially rectangular section.

18. The electrochemical cell as defined in claim 17, wherein said rectangular section has a square cross section.

19. The electrochemical cell as defined in claim 15, wherein said cover comprises a round cover.

20. The electrochemical cell as defined in claim 15, wherein said container comprises a steel can.

21. An electrochemical cell comprising:

a container having a substantially prismatic section with a substantially prismatic radial cross section, and further having sidewalls, a closed bottom end, and a top end;

a cathode disposed in said container substantially within said prismatic section;

an anode disposed within a cylindrical volume of said prismatic section of said container;

a separator disposed between said anode and said cathode; and

a cover assembled on the top end of said container.

22. The electrochemical cell as defined in claim 21, wherein said container further comprises a cylindrical section having a round top end.

23. The electrochemical cell as defined in claim 22, wherein said cover is substantially round and is assembled to said round top end.

24. The electrochemical cell as defined in claim 21, wherein said substantially prismatic section comprises a substantially rectangular section.

25. The electrochemical cell as defined in claim 21, wherein said container comprises a steel can.

26. An electrochemical cell comprising:

a container having a substantially rectangular section with a substantially rectangular radial cross section and a closed bottom end, said container further having a cylindrical section with a round top end;

a cathode housed substantially within said rectangular section;

an anode disposed within a substantially cylindrical volume of said rectangular section;

a separator disposed between said anode and said cathode; and

a round cover assembled to said round top end.

27. The electrochemical cell as defined in claim 26, wherein said substantially rectangular section has a substantially square cross section.

28. A multiple cell battery comprising:

a rectangular battery housing;

a positive contact terminal;

a negative contact terminal; and

a plurality of electrochemical cells assembled in said rectangular battery housing and in electrical contact with said positive and negative contact terminals, each of said plurality of cells having a substantially rectangular section with a substantially rectangular radial cross section and housing an anode, a cathode, and a separator with said anode disposed within a cylindrical volume of said rectangular section, each of said plurality of cells further having a round cover assembled to said cylindrical end.

29. The battery as defined in claim 28, wherein said substantially rectangular section has a substantially square cross section.

30. A method of assembling an electrochemical cell comprising the steps of:

providing a container having a substantially prismatic section with a substantially prismatic radial cross section and a closed bottom end, said container further having a cylindrical section having an open round top end;

dispensing a cathode substantially within said prismatic section of said container;

dispensing a separator substantially within said prismatic section of said container and having one face against said cathode;

dispensing an anode substantially within said prismatic section and against another face of said separator; and

assembling a cover to said round top end.

31. The method as defined in claim 30, further comprising the steps of:

dispensing said cathode in a cylindrical container;

placing said cylindrical container in a prismatic mold; and

injecting a ramrod through a central portion of said cylindrical container to form an anode cavity and reshape said cylindrical container to the configuration of said prismatic mold so as to provide said substantially prismatic section.

32. The method as defined in claim 31, wherein said substantially prismatic section comprises a substantially rectangular section.

33. The method as defined in claim 30, wherein said cover comprises a round cover.

34. The method as defined in claim 30, wherein said step of dispensing an anode further comprises dispensing said anode substantially within a cylindrical volume of said prismatic section.

35. The method as defined in claim 30, further comprising the step of dispensing a current collector in contact with said anode.

36. A method of assembling an electrochemical cell comprising the steps of:

providing a container having a substantially prismatic section with a substantially prismatic radial cross section, said container having a closed bottom end and an open top end;

dispensing a cathode substantially within said prismatic section of said container;

dispensing a separator substantially within said prismatic section of said container and having one face against said cathode;

dispensing an anode substantially within said prismatic section and against another face of said separator; and

assembling a cover to said round top end.

37. The method as defined in claim 36, wherein said step of providing a container having a substantially prismatic section further comprises providing a cylindrical section with said open round top end provided on said cylindrical section.

38. The method as defined in claim 36, wherein said substantially prismatic section comprises a substantially rectangular section.

39. The method as defined in claim 36, further comprising the steps of:

dispensing said cathode in a cylindrical container;

placing said cylindrical container in a prismatic mold; and

injecting a ramrod through a central portion of said cylindrical container to form an anode cavity and reshape said cylindrical container to the configuration of said prismatic mold so as to provide said substantially prismatic section.

40. The method as defined in claim 36, further comprising the step of dispensing a current collector in contact with said anode.

41. A method of assembling a multiple cell battery comprising the steps of:

providing a battery housing having sidewalls, a bottom, and a top;

providing positive and negative contact terminals on said housing;

providing a plurality of electrochemical cells each having a substantially prismatic section with a substantially prismatic radial cross section and housing active cell materials and a cylindrical end with a cover assembled to said cylindrical end; and

assembling an array of said plurality of electrochemical cells side-by-side within said rectangular housing and in electrical contact with said positive and negative contact terminals such that said array of electrochemical cells substantially conform to the housing so that flat

surfaces of cell walls of adjacent cells face each other and conform substantially to said battery housing.

42. The method as defined in claim 41, wherein said substantially prismatic section comprises a substantially rectangular section.

43. The method as defined in claim 41, wherein said cover comprises a round cover.

44. The method as defined in claim 41, wherein said step of providing a plurality of electrochemical cells further comprises providing each cell with an anode disposed within a cylindrical volume of said prismatic section.

45. The method as defined in claim 41, wherein said step of providing a plurality of electrochemical cells further comprises the steps of:

dispensing a cathode in a cylindrical container;

placing said cylindrical container in a prismatic mold;

injecting a ramrod through a central portion of said cylindrical container to form an anode cavity and reshape said cylindrical container to the configuration of said mold so as to provide said prismatic section; and

dispensing an anode in said anode cavity.

46. The method as defined in claim 41, further comprising the step of electrically connecting each of said plurality of electrochemical cells in series.

47. The method as defined in claim 41, wherein said step of providing a battery housing comprises providing a rectangular battery housing.

48. A method of assembling a multiple cell battery comprising the steps of:

providing a battery housing having side walls, a bottom, and a top;

providing positive and negative contact terminals on said housing;

providing a plurality of electrochemical cells each having a substantially prismatic section with a substantially prismatic radial cross section and housing a cathode, an anode, and a separator, said anode being disposed within a cylindrical volume of said prismatic section; and

assembling an array of said plurality of electrochemical cells side-by-side within said housing and an electrical contact with said positive and negative contact terminals such that said array of electrochemical cells substantially conform to said housing so that flat surfaces of cell walls of adjacent cells face each other and substantially conform to said battery housing.

49. The method as defined in claim 48, wherein said step of providing a plurality of electrochemical cells further comprises providing a cylindrical end on each of said electrochemical cells.

50. The method as defined in claim 48, wherein said substantially prismatic section comprises a substantially rectangular section.

51. The method as defined in claim 48, wherein said step of providing a plurality of electrochemical cells further comprises the steps of:

dispensing a cathode in a cylindrical container;

placing said cylindrical container in a prismatic mold;

injecting a ramrod through a central portion of said cylindrical container to form an anode cavity and reshape said cylindrical container to the configuration of said mold so as to provide said prismatic section; and

dispensing an anode in said anode cavity.

52. The method as defined in claim 48, further comprising the step of electrically connecting each of said plurality of electrochemical cells in series.

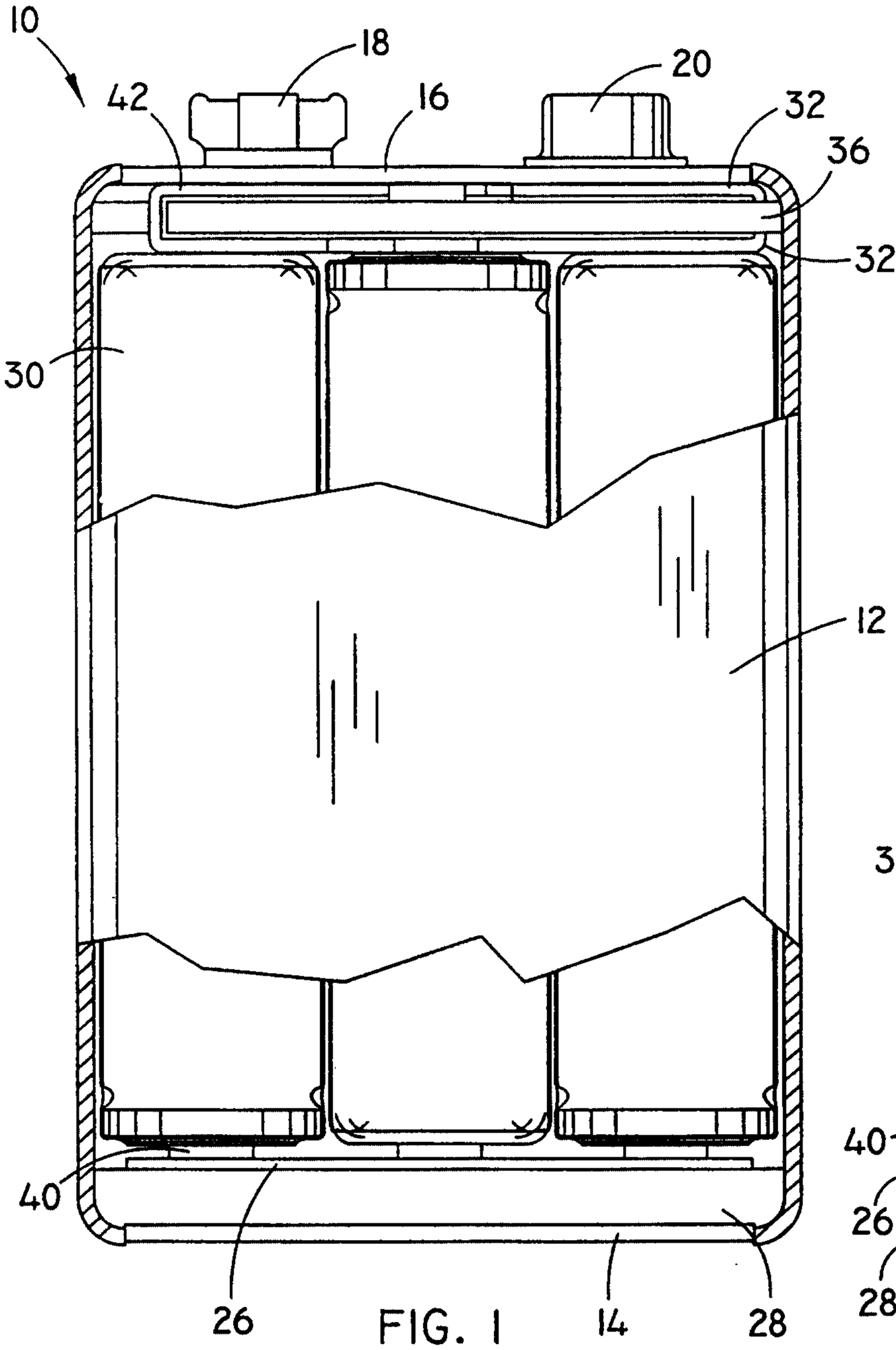

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FIG. 1

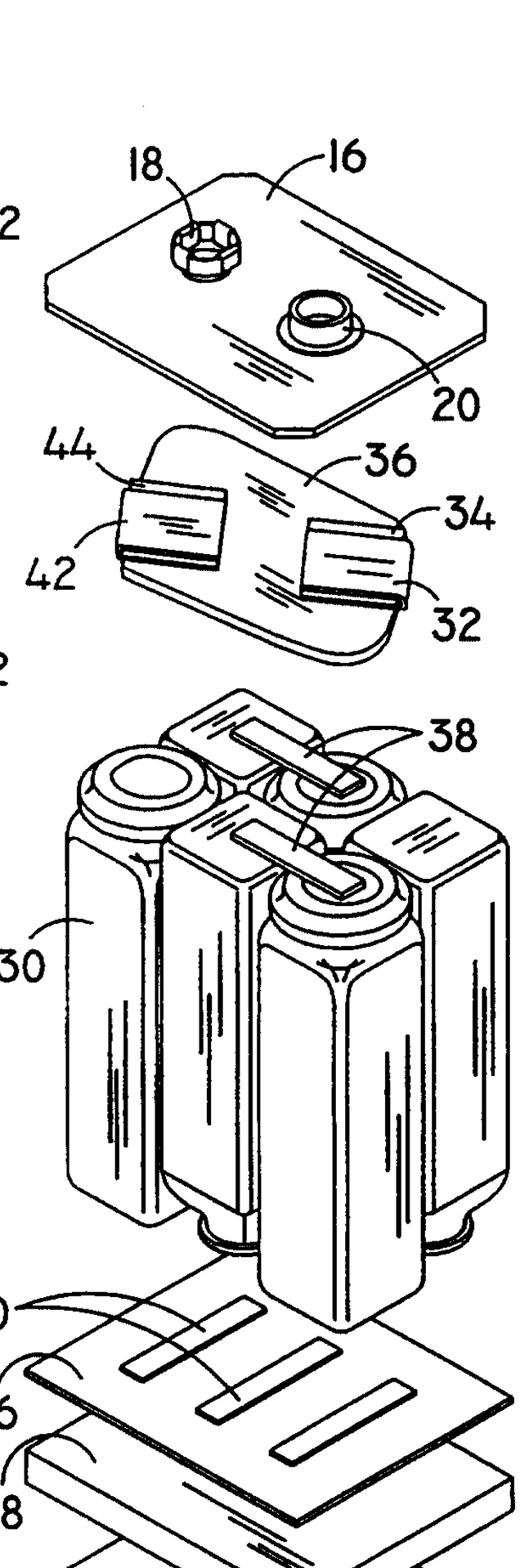
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FIG. 3

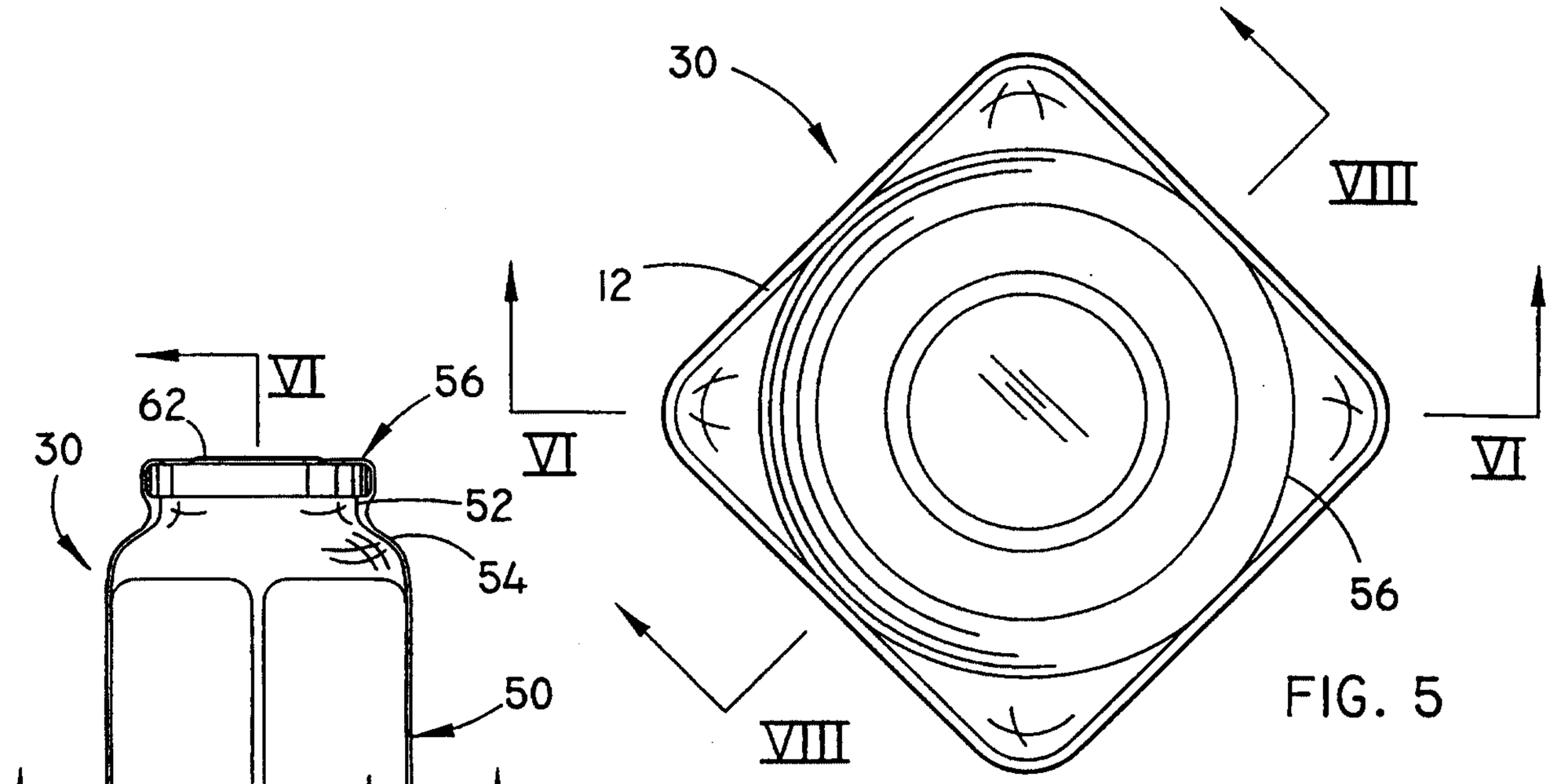


FIG. 5

FIG. 4

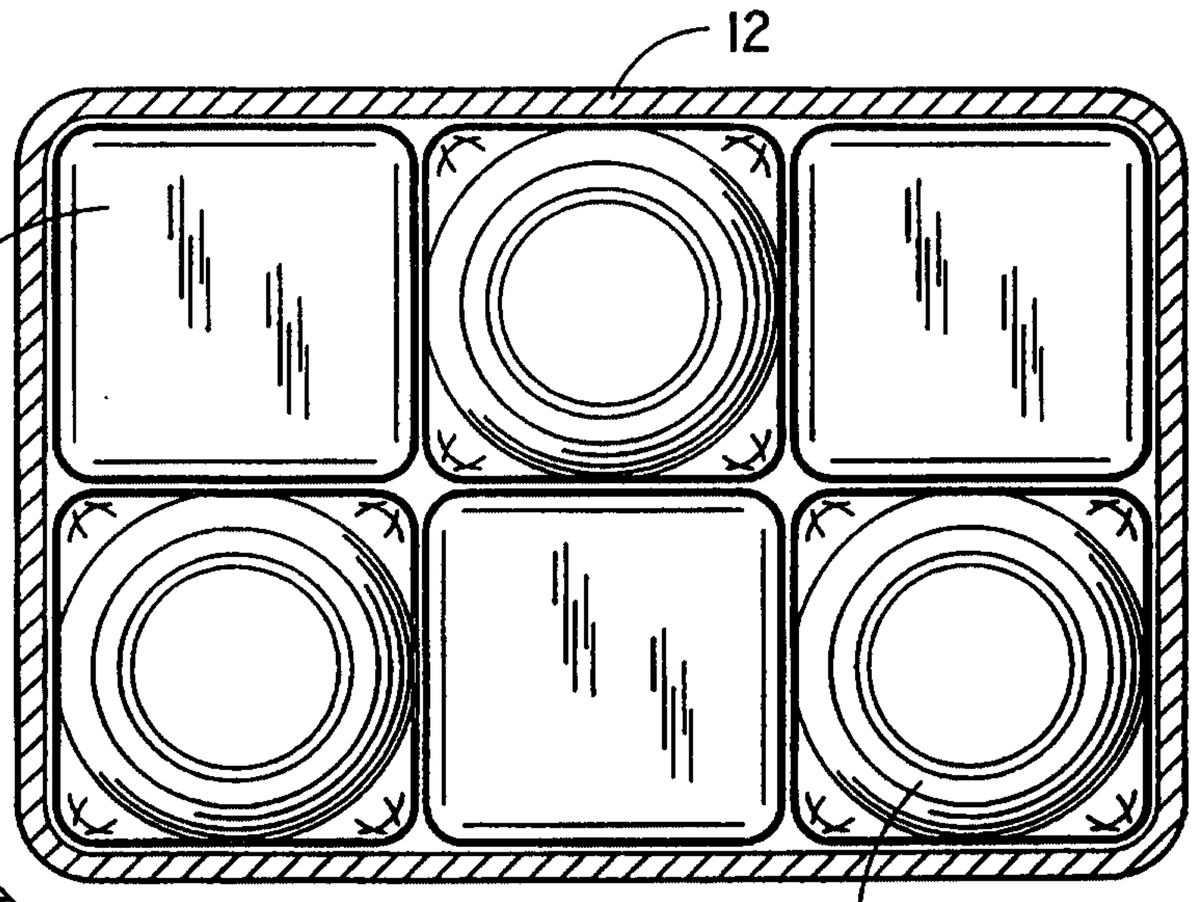


FIG. 2

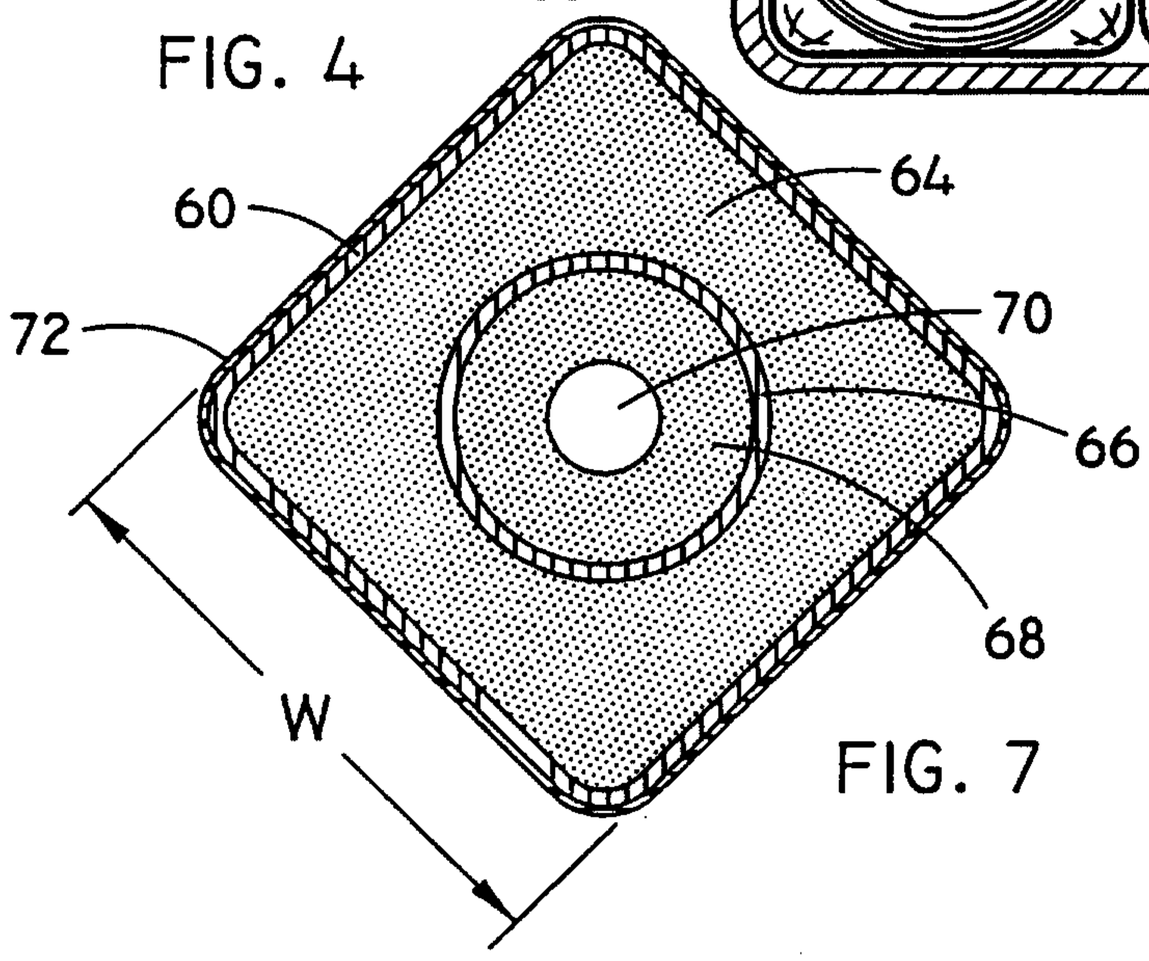
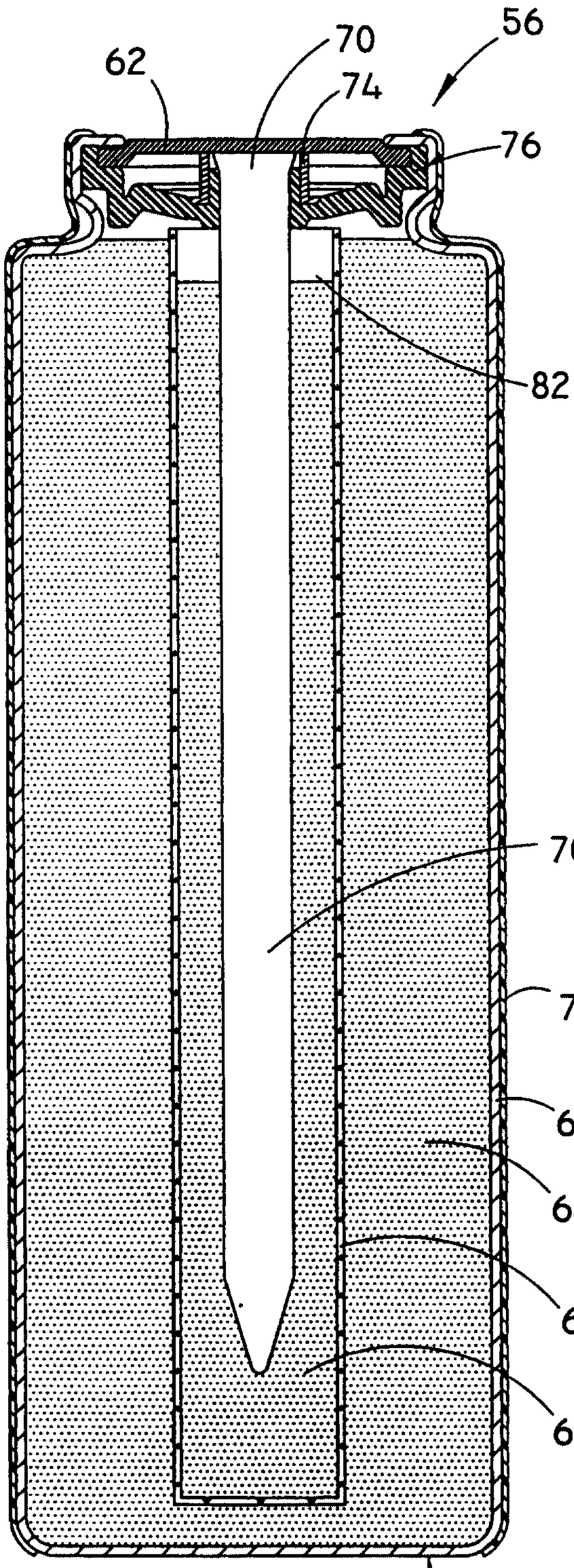


FIG. 7


62
70
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74
76
82
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68
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FIG. 6

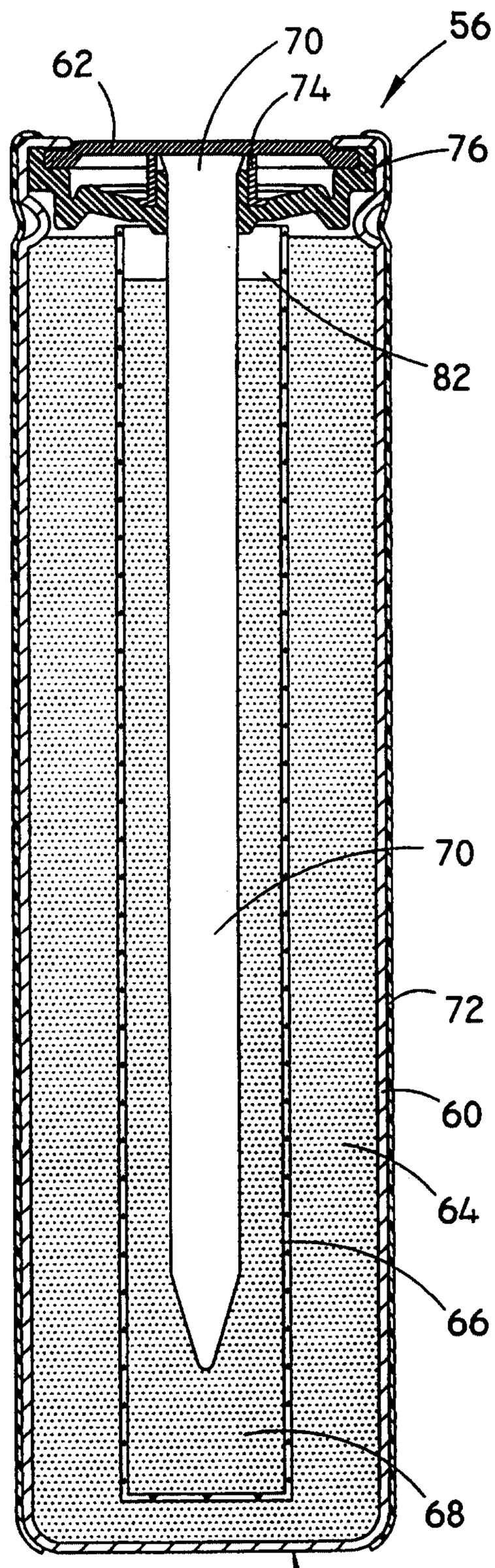
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FIG. 8