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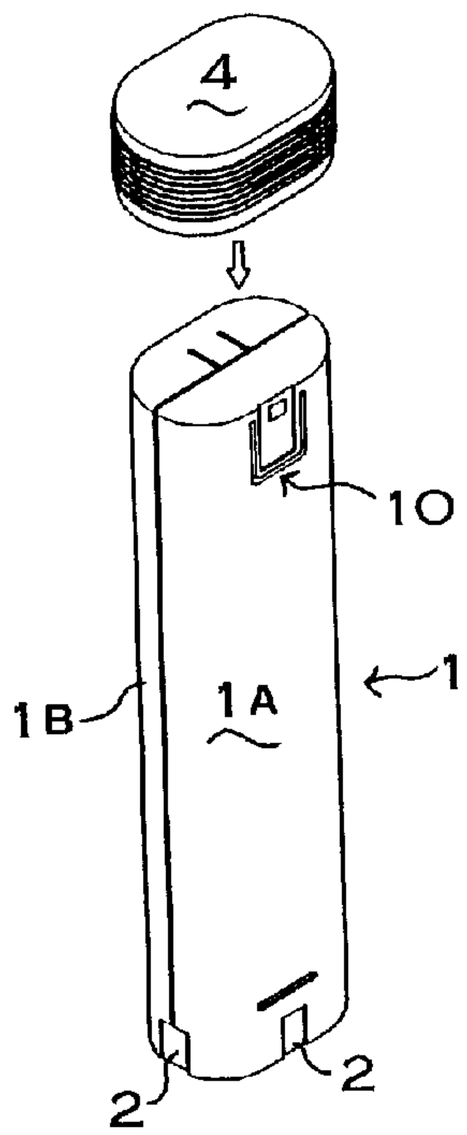


(57) Abrégé/Abstract:
The battery pack which can be attached independent of orientation houses rechargeable batteries within its case and has positive and negative (+ -) charge-discharge terminals at one end of the case. The charge-discharge terminals are arranged to connect to electrical apparatus without regard to the orientation of the front or back of the case. The + - charge-discharge terminals are sheet metal bent in flat-sided c-shapes, and comprise a parallel charge-discharge terminal piece which attaches to the case parallel to the case opening plane and a perpendicular charge-discharge terminal piece which attaches to the case perpendicular to the parallel charge-discharge terminal piece. The parallel charge-discharge terminal piece attaches by fitting into an attachment section formed as a single piece in the case opening. The open sides of the c-shaped parallel charge-discharge terminal piece and perpendicular charge-discharge terminal piece face each other in opposite fore and aft directions, and the two terminal pieces attach to the case in an orthogonal fashion.

Battery Pack which can be Attached

Abstract

The battery pack which can be attached independent of orientation houses rechargeable batteries within its case and has positive and negative (+ -) charge-discharge terminals at one end of the case. The charge-discharge terminals are arranged to connect to electrical apparatus without regard to the orientation of the front or back of the case. The + - charge-discharge terminals are sheet metal bent in flat-sided c-shapes, and comprise a parallel charge-discharge terminal piece which attaches to the case parallel to the case opening plane and a perpendicular charge-discharge terminal piece which attaches to the case perpendicular to the parallel charge-discharge terminal piece. The parallel charge-discharge terminal piece attaches by fitting into an attachment section formed as a single piece in the case opening. The open sides of the c-shaped parallel charge-discharge terminal piece and perpendicular charge-discharge terminal piece face each other in opposite fore and aft directions, and the two terminal pieces attach to the case in an orthogonal fashion.

Battery Pack which can be Attached

Background of the Invention

This invention relates to a battery pack which can attach to electrical equipment regardless of the orientation of its front and back sides.

Battery packs in general use today have positive and negative (+ -) charge-discharge terminals disposed in opposing locations on the end of the case. If this type of battery pack is attached to an electrical apparatus with the front and back of the battery pack inverted, the + - polarity will be reversed. The electrical apparatus may malfunction when the battery pack is connected with reverse polarity. In addition, large currents can flow in the battery pack and electrical apparatus resulting in heating to abnormally high temperatures.

To prevent these harmful effects, battery packs have been configured so they cannot be connected with reverse polarity. Namely, the battery pack and electrical apparatus have been made in special shapes that allow attachment in one orientation only. As a result, the battery pack and the battery pack attachment section of the electrical apparatus must be formed in complex shapes. In addition, the user must determine the proper battery pack attachment orientation judging from the shapes of the battery pack and the electrical apparatus. This makes it more difficult to simply attach the battery pack to the electrical apparatus. Therefore, this system also has the drawback that children, the aged, and users who are not mechanically inclined cannot use it conveniently.

This drawback can be eliminated by a battery pack configuration that allows attachment without regards to the orientation of the front and back of the battery pack. Namely, this drawback can be eliminated by a battery pack which can

be rotated 180° and still be attached. A battery pack which realizes such a configuration is cited, for example, in Japanese Non-Examined Utility Model Publication No. 2-12157 issued Jan. 25,1990. As shown in Fig. 1, the battery pack cited in this disclosure has a positive charge-discharge terminal 102 disposed at the center of one end of the case 101 and negative charge-discharge terminals 102 disposed on both sides of the positive terminal 102. This results in attachment without specified orientation.

The battery pack shown in Fig. 1 can reliably connect its + - charge-discharge terminals 102 to the electrical apparatus even when the battery pack is rotated 180° and attached reversing the front and back. Therefore, it has the feature that it can be easily attached ignoring the attachment orientation. However, this type of battery pack has the drawback that it is difficult to accurately mount the charge-discharge terminals 102 in the specified locations on the case 101. Further, since the + - charge-discharge terminals 102 which are exposed outside the case 101 connect internally through leads 103, assembly of this structure is difficult. Finally, this structure also has the drawback that it is difficult to reliably prevent internal short circuiting of the + - leads 103 and the charge-discharge terminals 102.

The present invention was developed to overcome these and other drawbacks. It is thus a primary object of the present invention to provide a battery pack which can be attached independent of orientation wherein the + - charge-discharge terminals can be simply, easily, and accurately mounted in the specified locations on the case without short circuiting.

The above and further objects and features of the invention will more fully be apparent from the following detailed description with accompanying drawings.

Summary of the Invention

The battery pack of the present invention houses rechargeable batteries inside its case and is provided with + - charge-discharge terminals at one end of the case. The charge-discharge terminals are mounted on the case in a manner allowing attachment to an electrical apparatus with 180° rotation of the case, that is without regards to orientation of the front and back of the case.

Further, the battery pack which can be attached independent of orientation of the present invention is provided with the following unique structure. Each set of + or - charge-discharge terminals is a sheet metal piece bent in a flat-sided c-shape to form a main body section connected to bent sections on either side. The + - charge-discharge terminals are made up of a parallel charge-discharge terminal piece and a perpendicular charge-discharge terminal piece. The parallel charge-discharge terminal piece is mounted on the case parallel to the plane of the case opening. The perpendicular charge-discharge terminal piece is mounted on the case perpendicular to the parallel charge-discharge terminal piece. The parallel charge-discharge terminal piece mounts by fitting into an attachment section formed as a single piece with the open case section. The parallel charge-discharge terminal piece is mounted with both surfaces of the main body section and bent sections parallel to the direction for case separation. This allows the two halves of the divided case to connect by parallel movement. The perpendicular charge-discharge terminal piece is mounted with both ends connecting the halves of the divided case. The perpendicular charge-discharge terminal piece is mounted with both surfaces of the main body section parallel to the direction for case separation. The parallel charge-discharge terminal piece and the perpendicular charge-discharge terminal piece are mounted in a mutually perpendicular fashion with the open sides of their c-shapes facing in mutual opposition.

This configuration of battery pack has the feature that short circuits between the + - charge-discharge terminals are effectively prevented, and that the + - charge-discharge terminals can be simply, easily, and accurately mounted in specified locations in the case. This is because the + - charge-discharge terminals are made up of sheet metal bent into flat-sided c-shaped pieces; the parallel charge-discharge terminal piece and the perpendicular charge-discharge terminal piece. The parallel charge-discharge terminal piece fits in an attachment section provided in the case opening. The parallel charge-discharge terminal piece and the perpendicular charge-discharge terminal piece attach to the case with the open sides of their c-shapes facing in opposition. Finally, the bent sections provided at both ends of the perpendicular charge-discharge terminal piece connect the two halves of the divided case. In this configuration of battery pack, the parallel charge-discharge terminal piece is mounted in the case opening and then the case halves are connected. The perpendicular charge-discharge terminal piece is installed prior to connecting the case halves or after connecting the case halves.

Brief Description of the Drawings

Fig. 1 is an oblique view of a prior art battery pack which can be attached independent of orientation.

Fig. 2 is an oblique view of an embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 3 is an exploded oblique view showing the manufacturing process of an embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 4 is an exploded oblique view showing the manufacturing process of an embodiment of the battery pack

which can be attached independent of orientation of the present invention.

Fig. 5 is an exploded oblique view showing the manufacturing process of an embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 6 is an exploded oblique view showing the manufacturing process of an embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 7 is a cross-section view of an embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 8 is a bottom view of an embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 9 is an exploded oblique view showing the manufacturing process of a second embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 10 is an exploded oblique view showing the manufacturing process of a second embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 11 is an exploded oblique view showing the manufacturing process of a second embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 12 is an exploded oblique view showing the manufacturing process of a second embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 13 is a partially enlarged cross-section view of a second embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 14 is a bottom view of a second embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 15 is an exploded oblique view showing the manufacturing process of a third embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 16 is an exploded oblique view showing the manufacturing process of a third embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 17 is an exploded oblique view showing the manufacturing process of a third embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 18 is an exploded oblique view showing the manufacturing process of a third embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 19 is a partially enlarged cross-section view of a third embodiment of the battery pack which can be attached independent of orientation of the present invention.

Fig. 20 is a cross-section view, a side view, and a bottom view of the perpendicular charge-discharge terminal piece of a third embodiment of the present invention.

Fig. 21 is an oblique view showing the solder region of the parallel charge-discharge terminal piece and lead contained in the battery pack of another embodiment of the present invention.

Detailed Description of the Invention

Turning to Figs. 2 through 6, the battery pack which can be attached independent of orientation is provided with a case 1 which separates in two, a cap 4 which connects on the aft end of the case 1, four rechargeable batteries 5 which are

housed in the case 1, and + - charge-discharge terminals 2 which attach to the case 1.

The case 1 is made up of case halves 1A and 1B formed from plastic. Case 1A and case 1B are formed in a shape that allows four rechargeable batteries 5 to be held inside when arranged in two rows. A plurality of lateral ribs 6 are formed on the inside surface of the case 1 as a single piece with the case 1 to retain the batteries in fixed positions. The upper surfaces of the lateral ribs 6 are curved to conform to the shape of the rechargeable batteries 5. Further, in the center region of the lateral ribs 6, a partition 8 to enclose a rectangular circuit breaker 7 in a fixed position is also formed as a single piece with the case 1.

Fastener windows 9 are formed in five locations as a single piece with case 1B to allow the case halves 1A and 1B to be joined with the rechargeable batteries 5 contained inside. The fastener windows 9 are formed with case 1B projecting out from the edges of the opening of case 1B. The fastener windows 9 are provided in two locations on the front end edge which exposes charge-discharge terminals outside the case 1, in the center of both side edges, and in one location on the aft end edge of the case. When the case halves 1A and 1B are joined, the fastener windows 9 project into the inside surface of case 1A. In locations where the fastener windows 9 insert, case 1A has hooks (not illustrated) which are formed as a single piece with case 1A. When the two case halves 1A and 1B are joined together, the hooks engage with the fastener windows 9 to connect case 1A to case 1B. Further, as shown in the figures, the case 1 inserts into the aft end cap 4 to more reliably join the two case halves 1A and 1B. This structure has the feature that case 1A and case 1B can be easily joined without using locking screws or bolts.

The cap 4 is formed with an interior shape that allows insertion of the aft end of the connected case 1. Further, the cap 4 is formed in a configuration that does not allow it to be pulled off once the aft end of the case 1 is inserted.

To achieve this, the cap 4 shown in the cross-section of Fig. 7 is provided with projections 4a on its inner surface and the case 1 is provided with detents 10 for these projections 4a to fit into. The projections 4a insert into the detents 10 and the cap 4 attaches to the case 1 in a manner that cannot be dislodged. The outer surfaces of the cap 4 are provided with rough topology to avoid slipping when grasped. The battery pack with the cap 4 fixed to its aft end has the feature that not only does the cap 4 reliably hold the case 1 together, but it also allows the battery pack to be easily engaged and disengaged from electrical equipment by grasping the cap 4.

Alignment ribs 11 are formed as a single piece in the corners of the front end of the case 1A and case 1B creating attachment sections 1a to fit one part of the charge-discharge terminals 2, namely a parallel charge-discharge terminal piece 2A, and maintain it in a fixed location. The alignment ribs 11 are formed as a single piece in L-shapes in the corners of the case opening.

Electrode windows 12 are opened through case 1A and case 1B outside the alignment ribs 11 to expose bent sections 2b of the parallel charge-discharge terminal piece 2A outside the case 1. In addition, electrode windows 13 are also opened through case 1A and case 1B to expose bent sections 2b of a perpendicular charge-discharge terminal piece 2B outside the case 1. The perpendicular charge-discharge terminal piece 2B mounts in the case 1 perpendicular to the parallel charge-discharge terminal piece 2A.

Further, rib 14 and projection 15 are formed as a single piece on the inner surface of case 1B for mounting the perpendicular charge-discharge terminal piece 2B in a fixed position. The projection 15 is disposed in a location to insert into a hole 16 provided through a bent section 2b of the perpendicular charge-discharge terminal piece 2B. The rib 14 is disposed in a location to insert through a slit 17 provided in bent section 2b of the perpendicular charge-discharge terminal piece 2B. After insertion of the

projection 15 through the hole 16 in bent section 2b, the tip of projection 15 is pressed and heated to fix the perpendicular charge-discharge terminal piece 2B to the case 1B.

The rib 14 inserts through the slit 17 in the perpendicular charge-discharge terminal piece 2B and prevents movement of the perpendicular charge-discharge terminal piece 2B out of position. The perpendicular charge-discharge terminal piece 2B joined to case 1B via projection 15 and hole 16 can rotate around projection 15 as a pivot point, but rib 14 and slit 17 prevent that rotation and accurately retain the perpendicular charge-discharge terminal piece 2B in proper position. Further, the rib 14 passes through slit 17 in the perpendicular charge-discharge terminal piece 2B and presses the inside of the bent section 2b on the opposite side against the inner surface of case 1A. Thus the perpendicular charge-discharge terminal piece 2B with its bent section 2b pressed by the end of rib 14 is effectively prevented from shape distortion leading to poor electrical contact even when pressed upon through the case 1 electrode window 13. Specifically, the rib 14 serves not only to accurately retain the perpendicular charge-discharge terminal piece 2B in position, but also serves to insure electrical connection to an electrical apparatus.

Further, as shown in the figures, a support rib 18 is formed as a single piece on the inside surface of case 1B to prevent movement of the rechargeable batteries 5 as a result of mechanical shock. It is possible to imagine rechargeable batteries 5 moving out of position and short circuiting due to mechanical shock such as dropping the battery pack. The support rib 18 is disposed between the rechargeable batteries 5 and the charge-discharge terminals 2, and prevents movement of the rechargeable batteries 5 towards the charge-discharge terminals 2. As shown in Fig. 4, the support rib 18 is formed as a single piece in a flat sided c-shape disposed at the end of the rechargeable batteries 5 arranged in two rows. When

mechanical shock tries to move the rechargeable batteries 5 towards the charge-discharge terminals 2, the flat-sided c-shaped support rib 18 reliably stops this movement to effectively prevent battery pack internal short circuits.

The charge-discharge terminals 2 are made up of a parallel charge-discharge terminal piece 2A and a perpendicular charge-discharge terminal piece 2B. The parallel charge-discharge terminal piece 2A and the perpendicular charge-discharge terminal piece 2B are fabricated by bending sheet metal into flat-sided c-shapes. The flat-sided c-shaped charge-discharge terminals 2 take the form of a main body section 2a joined to bent sections 2a on either side. The battery pack shown in the figures has charge-discharge terminals 2 with a parallel charge-discharge terminal piece 2A which is positive and a perpendicular charge-discharge terminal piece 2B which is negative. However, the charge-discharge terminals can also be of reverse polarity.

The parallel charge-discharge terminal piece 2A mounts along the edge of the case 1 opening. The end portions of the bent sections 2b of the parallel charge-discharge terminal piece 2A are bent inward again, and the bent sections 2b attach around the outside of the alignment ribs 11 provided on the case 1 to dispose the parallel charge-discharge terminal piece in a fixed location in the case 1. The parallel charge-discharge terminal piece 2A mounts at the interface region of case halves 1A and 1B with the open side of its c-shape facing towards the front end of the case 1. In other words, as shown in Fig. 3, the parallel charge-discharge terminal piece 2A mounts with its main body section positioned towards the interior of the case 1 and its bent sections 2b extending towards the front end of the case 1. Both ends of the main body section 2a of the parallel charge-discharge terminal piece 2A fit into grooves 20 provided between alignment ribs 11 and a case a perimeter rib 19 to prevent fore and aft movement with respect to the case.

To allow the case halves 1A and 1B to be joined together, both surfaces of the main body section 2a and of the bent sections 2b of the parallel charge-discharge terminal piece 2A are parallel to the direction of separation of the case 1 when the parallel charge-discharge terminal piece 2A is installed in the case 1B. The parallel charge-discharge terminal piece 2A installed in case 1B connects to the positive terminal of the rechargeable batteries 5 via leads 21.

The bent sections 2b of the perpendicular charge-discharge terminal piece 2B connect across the case halves 1A and 1B. The bent sections 2b of the perpendicular charge-discharge terminal piece 2B fit into the electrode windows 13 of case 1A and case 1B, and are provided with projecting sections 2c to protrude from the electrode windows 13 out of the case 1. As shown in Fig. 4, the lower end bent section 2b of the perpendicular charge-discharge terminal piece 2B is longer than the upper end bent section 2b, and is provided with the hole 16 and slit 17. The hole 16 is opened at a location for the projection 15 on the case 1B to insert through, and the slit 17 is opened at a location for the rib 14 on the case 1B to insert through. In addition, the lower end bent section 2b is further extended beyond the hole 16 region, and a lead wire 22 is soldered to its end. The lead wire 22 is connected to the negative terminal of the rechargeable batteries 5 through a circuit breaker 7.

The direction of the open side of the c-shaped perpendicular charge-discharge terminal piece 2B is opposite of that of the parallel charge-discharge terminal piece 2A. As shown in Fig. 3, the main body section 2a of the perpendicular charge-discharge terminal piece 2B is disposed against the inside surface of the front end of the case 1, and the bent sections 2b extend from the front end towards the aft end of the case 1. Thus the perpendicular charge-discharge terminal piece 2B is installed in the case 1 with the open side of its c-shape facing aft.

A battery pack with the structure described above is assembled in the following fashion.

(1) As shown in Fig. 4, lead wire 22 is soldered to the end of the bent section 2b of the perpendicular charge-discharge terminal piece 2B connecting the circuit breaker 7.

(2) The perpendicular charge-discharge terminal piece 2B and the parallel charge-discharge terminal piece 2A are installed in case 1B as shown in Fig. 5 with the open sides of their c-shapes facing in mutual opposition. The circuit breaker 7 is solder connected to the negative terminal of the rechargeable batteries 5.

(3) As shown in Fig. 6, after three rechargeable batteries 5 are inserted in case 1B, the final rechargeable battery 5 is also inserted.

(4) After leads 21 are connected to the four rechargeable batteries 5, the positive terminal of the rechargeable batteries 5 is connected to the parallel charge-discharge terminal piece 2A via lead 21 as shown in Fig. 3.

(5) Case halve 1A is joined at the case opening of case halve 1B. Hooks (not illustrated) on case 1A catch in case 1B fastener windows 9 to mate case 1B and case 1A in an inseparable fashion.

(6) Finally, as shown in Fig. 2, the aft end of the case 1 is inserted into the cap 4 to insure the connection of case 1B and case 1A.

As shown in Fig. 8, the battery pack assembled in this fashion has positive charge-discharge terminals 2 exposed at both ends of the dividing line between the case 1, and has negative charge-discharge terminals 2 exposed on the surface of each of the case halves 1A and 1B.

Turning to Figs. 9 through 14 a second embodiment of the battery pack is shown. Comparing the battery pack shown in Figs. 9 through 13 with the battery pack shown in Figs. 2 through 6, the perpendicular charge-discharge terminal piece 92B and the connecting structure of case halves 91A and 91B are different. The perpendicular charge-discharge terminal

piece 92B of the battery pack of Figs. 9 through 14 connects to the circuit breaker 97 through a connecting terminal 923. The connecting terminal 923 connects to the circuit breaker 97 via the lead wire 922.

The tip of the connecting terminal 923 makes flexible contact with the end of the perpendicular charge-discharge terminal piece 92B. The connecting terminal 923 is provided with a hole 916 for insertion of a projection 915 established on the case 91B to retain the connecting terminal 923 in a fixed position on the case 91B. The connecting terminal 923 is fixed to the case 91B by inserting the projection 915 through the hole 916 and pressure heating the top of the projection 915 to flatten it.

Fastening holes 924 are provided at the ends of the bent sections 92b of the perpendicular charge-discharge terminal piece 92B. As shown in the cross-section of Fig. 13, fastening projections 925 formed as single pieces on the insides of case 91A and case 91B insert into the fastening holes 924. For the perpendicular charge-discharge terminal piece 92B with this structure, the ends of the bent sections 92b insert through the electrode widows 913 into the inside surfaces of the case 91 when the two case halves 91A and 91B have been joined together. The fastening holes 924 in the bent sections 92b inserted through the electrode widows 913 catch on the fastening projections 925 on the inside surfaces of the case 91 preventing their separation. The perpendicular charge-discharge terminal piece 92B attached in this fashion joins case 91A and case 91B such that they do not open. As shown in Figs. 9 and 14, this configuration of perpendicular charge-discharge terminal piece 92B attaches to the outside of case 91A and case 91B. Therefore, grooves 926 are formed in case 91A and case 91B to accept the main body section and part of the bent sections 92b of the perpendicular charge-discharge terminal piece 92B.

The case 91 shown in these and other figures is joined in the same manner as case 91 shown in Figs. 2 through 6 by

fastener windows 99 provided on case 91B and hooks on case 91A. Further, this case 91 is held together by the perpendicular charge-discharge terminal piece 92B. Still further, a locking screw 927 connects case 91 even more reliably. The locking screw 927 joins the halves of case 91 by passing through case 91A and screwing into a support strut 928 provided on case 91B. Finally, the after end of the case 91 inserts into cap 94 to further hold the case 91 together.

The battery pack shown in Figs. 9 through 14 has the feature that since the perpendicular charge-discharge terminal piece 92B is attached after joining case 91A and case 91B, short circuits between the perpendicular charge-discharge terminal piece 92B and the parallel charge-discharge terminal piece 92A are effectively prevented at the assembly stage. It also has the feature that the perpendicular charge-discharge terminal piece 92B can be easily attached. Further, it also has the feature that since the case halves 91A and 19B are held together by the perpendicular charge-discharge terminal piece 92B, the case 91 can be reliably joined together without screwing or bolting it together.

Finally turning to Figs. 15 through 20, a third embodiment of the battery pack is shown. Comparing the battery pack shown in Figs. 15 through 19 with the battery pack shown in Figs. 2 through 6, the structure of the perpendicular charge-discharge terminal piece 152B is different. The battery pack of Figs. 15 through 20 has a perpendicular charge-discharge terminal piece 152B shaped as shown in Fig. 20 attached to the case 151. The perpendicular charge-discharge terminal piece 152B of Fig. 20 has a main body section 152a provided with a punch-out projection 1529 and a connecting hole 1530. Further, both sides of the main body section 152a are bent to reinforce the main body section 152a.

The punch-out projection 1529 connects to case 151A and the connecting hole 1530 connects to case 151B. Consequently, as shown in Fig. 19, case 151A is provided with a locking

detent 1531 on its inside surface to mate with the punch-out projection 1529. A locking projection 1532 for insertion into the connecting hole 1530 is formed as a single piece on the inside surface of case 151B. When the case halves 151A and 151B are joined with the perpendicular charge-discharge terminal piece 152B installed in the prescribed location, the punch-out projection 1529 catches in the locking detent 1531 and the connecting hole 1530 engages with the locking projection 1532. Thus the case halves 151A and 151B are connected such that they cannot open by the main body section 152a of the perpendicular charge-discharge terminal piece 152B.

Further, the perpendicular charge-discharge terminal piece 152B is provided with a hole 1516 and slit 1517 in its bent section 152b for attachment to case 151B in the same manner as the perpendicular charge-discharge terminal piece 152B shown in Figs. 2 through 6. Projection 1515 which is formed as a single piece on case 151B inserts through the hole 1516, and projection 1515 is flattened by heat and pressure to fix the perpendicular charge-discharge terminal piece 152B to the case 151B.

The parallel charge-discharge terminal piece 152A connects to the positive terminal of the rechargeable batteries 155 via lead 1521. The lead 1521 can be soldered to the main body section 152a of the parallel charge-discharge terminal piece 152A as shown in Figs. 3, 9, and 15. However, as shown in Fig. 21, a connecting slit 2133 can be provided laterally in the main body section 212a of the parallel charge-discharge terminal piece 212B, and the lead 2121 can be inserted in connecting slit 2133 and soldered for a more reliable connection.

As this invention may be embodied in several forms without departing from the spirit of essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by

the description preceding them, and all changes that fall within the meets and bounds of the claims or equivalence of such meets and bounds thereof are therefore intended to be embraced by the claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A battery pack which can be attached to an electrical apparatus independent of orientation, said battery pack comprising:

rechargeable batteries;

a casing containing said rechargeable batteries and including a first case section, and a second case section secured to said first case section;

a first charge-discharge terminal piece engaged in attachment sections at a front end portion of said casing such that said first charge-discharge terminal piece is secured in position at the front end portion of the casing, said first charge-discharge terminal piece being formed of sheet metal which is bent into a C-shape having two bent sections and a main body section interconnecting said two bent sections, wherein said main body section is substantially parallel to an end wall of said casing;

a second charge-discharge terminal piece attached to at least one of said first and second casing sections, said second charge-discharge terminal piece being formed of sheet metal bent into a C-shape having two bent sections and a main body section interconnecting said bent sections, wherein said main body section of said second charge-discharge terminal piece is perpendicular relative to said main body section of said first charge-discharge terminal piece, and open sides of said C-shaped terminal pieces face in opposite directions.

2. A battery pack as claimed in claim 1, further comprising a projection formed integrally with said first case section, wherein one of said bent sections of said second charge-discharge terminal piece is provided with a through hole, and said projection is inserted into said through hole.

3. A battery pack as claimed in claim 2, wherein an end of said projection extending through said through hole is flattened to attach the second charge-discharge terminal piece to said case.

4. A battery pack as claimed in claim 1, further comprising fastening projections formed integrally on interior surfaces of said first and second case sections, respectively, wherein said bent sections of said second charge-discharge terminal piece have fastening holes and said fastening projections are engaged with said fastening holes to attach the second charge-discharge terminal piece to opposite sides of the case and to hold the first and second case sections together.

5. A battery pack as claimed in claim 1, further comprising a rib formed integrally with one of said first and second case sections, wherein one of said bent sections of said second charge-discharge terminal piece is provided with a slit, and said rib is inserted into said slit in order to retain the second charge-discharge terminal piece in a specified position within said case.

6. A battery pack as claimed in claim 1, wherein said main body section of said second charge discharge terminal piece is provided with a punched-out projection, and one of said first and second case sections is formed with a locking detent which mates with said punched-out projection.

7. A battery pack as claimed in claim 1, further comprising a C-shaped reinforcement rib formed integrally with one of said first and second case sections, wherein said C-shaped reinforcement rib is disposed between said rechargeable batteries and said charge-discharge terminal pieces in order to prevent the rechargeable batteries from

contacting said charge-discharge terminal pieces.

8. A battery pack as claimed in claim 1, wherein a lateral slit is provided in one of said charge-discharge terminal pieces, and a lead is inserted into said lateral slit and soldered.

9. A battery pack as claimed in claim 1, further comprising a cap provided on a rear end portion of said casing which is opposite relative to the front end portion of said casing at which said first and second charge-discharge terminal pieces are disposed.

10. A battery pack as claimed in claim 9, wherein said cap is provided with a roughened outer surface.

11. A battery pack as claimed in claim 1, wherein said attachment sections comprise alignment ribs formed integrally at corners of the front end portion of said casing, wherein said alignment ribs retain said first charge-discharge terminal piece in a fixed position.

12. A battery pack as claimed in claim 1, further comprising open electrode windows formed in said case, wherein said bent sections of said first charge-discharge terminal piece are positioned outwardly of said alignment ribs so as to be exposed to the exterior of said case through said electrode windows.

13. A battery pack as claimed in claim 1, further comprising a reinforcement rib projection from an inside surface of one of said first and second case sections, wherein said reinforcement rib is located between the rechargeable batteries and said charge-discharge terminal pieces.

14. A battery pack as claimed in claim 1, wherein said first charge-discharge terminal piece is electrically connected to a positive terminal of the rechargeable batteries, and said second charge-discharge terminal piece is electrically connected to a negative terminal of the rechargeable batteries.

15. A battery pack as claimed in claim 1, further comprising open electrode windows formed in said case, wherein said bent sections of said second charge-discharge terminal piece are positioned in said electrode windows so as to be exposed exteriorly of said case.

16. A battery pack as claimed in claim 15, wherein said electrode windows are disposed on opposite sides of said case.

FIG. 1

PRIOR ART

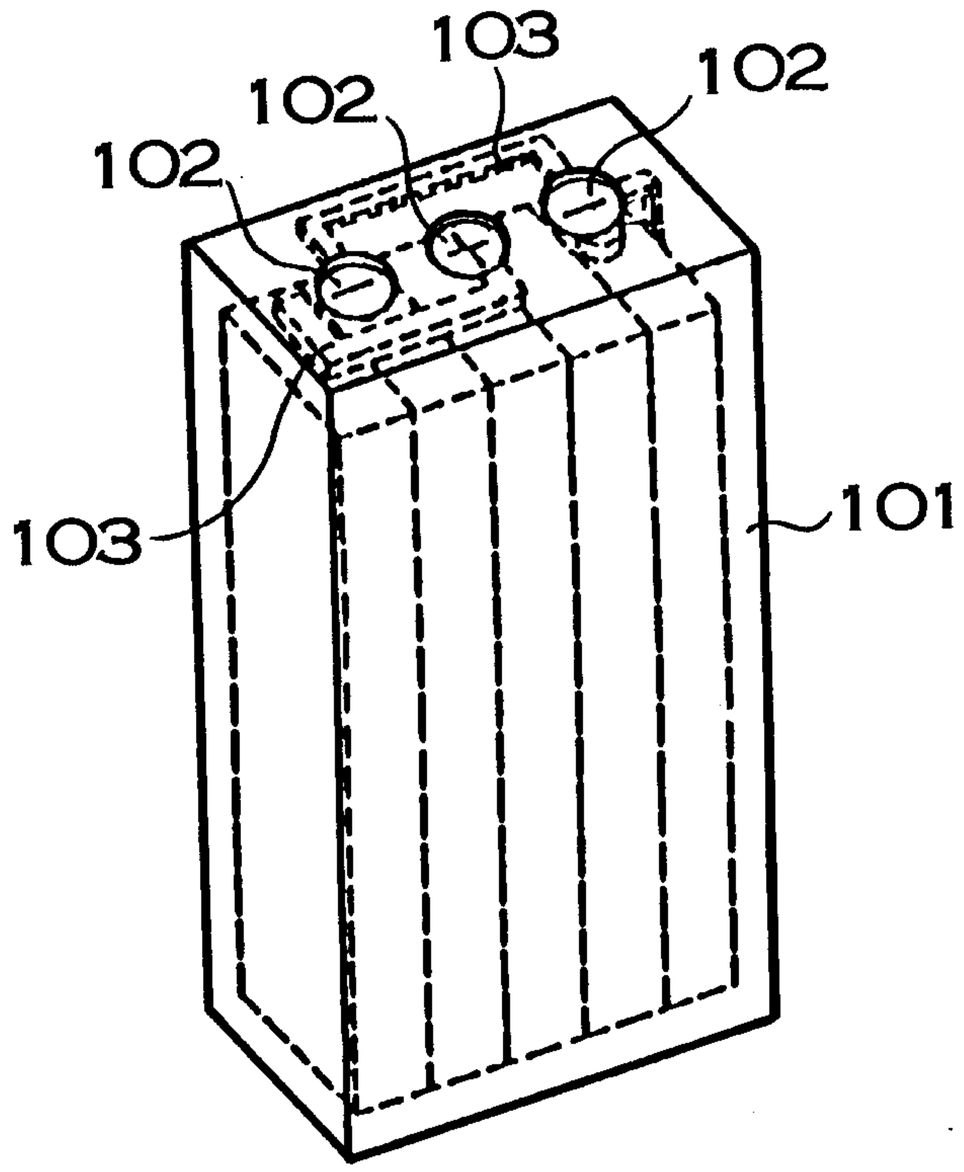


FIG. 2

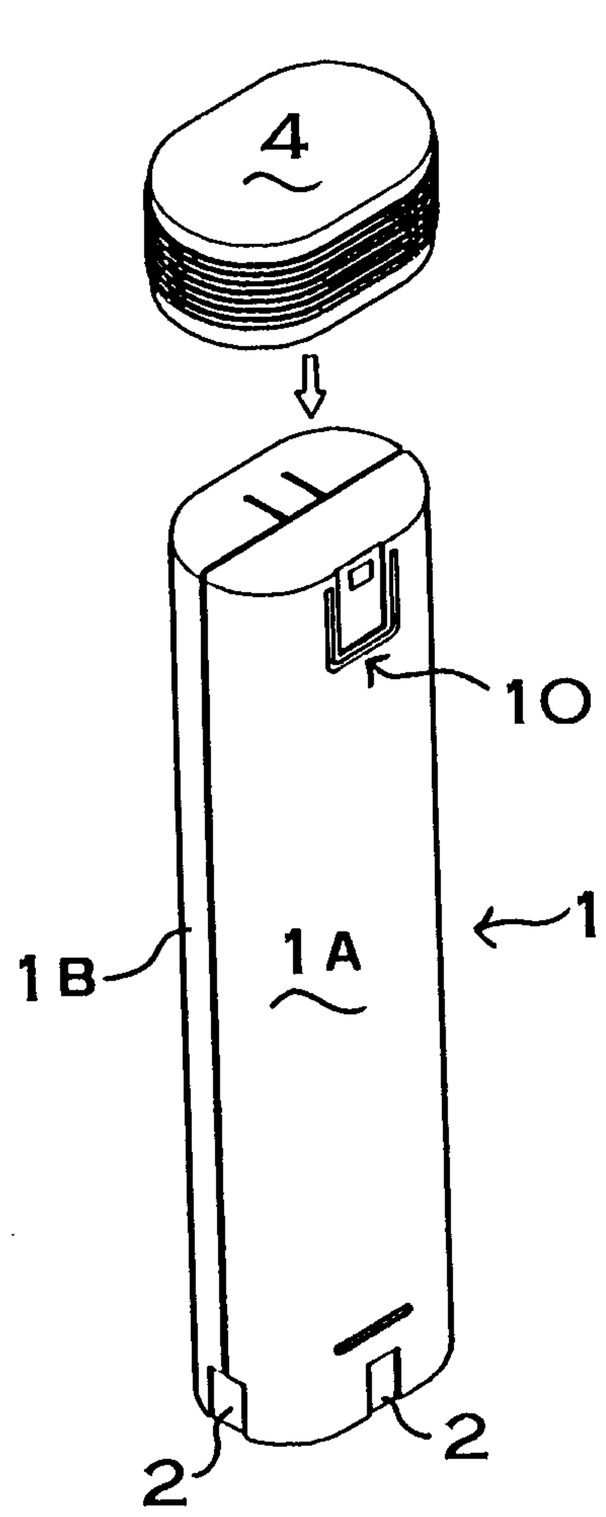


FIG. 3

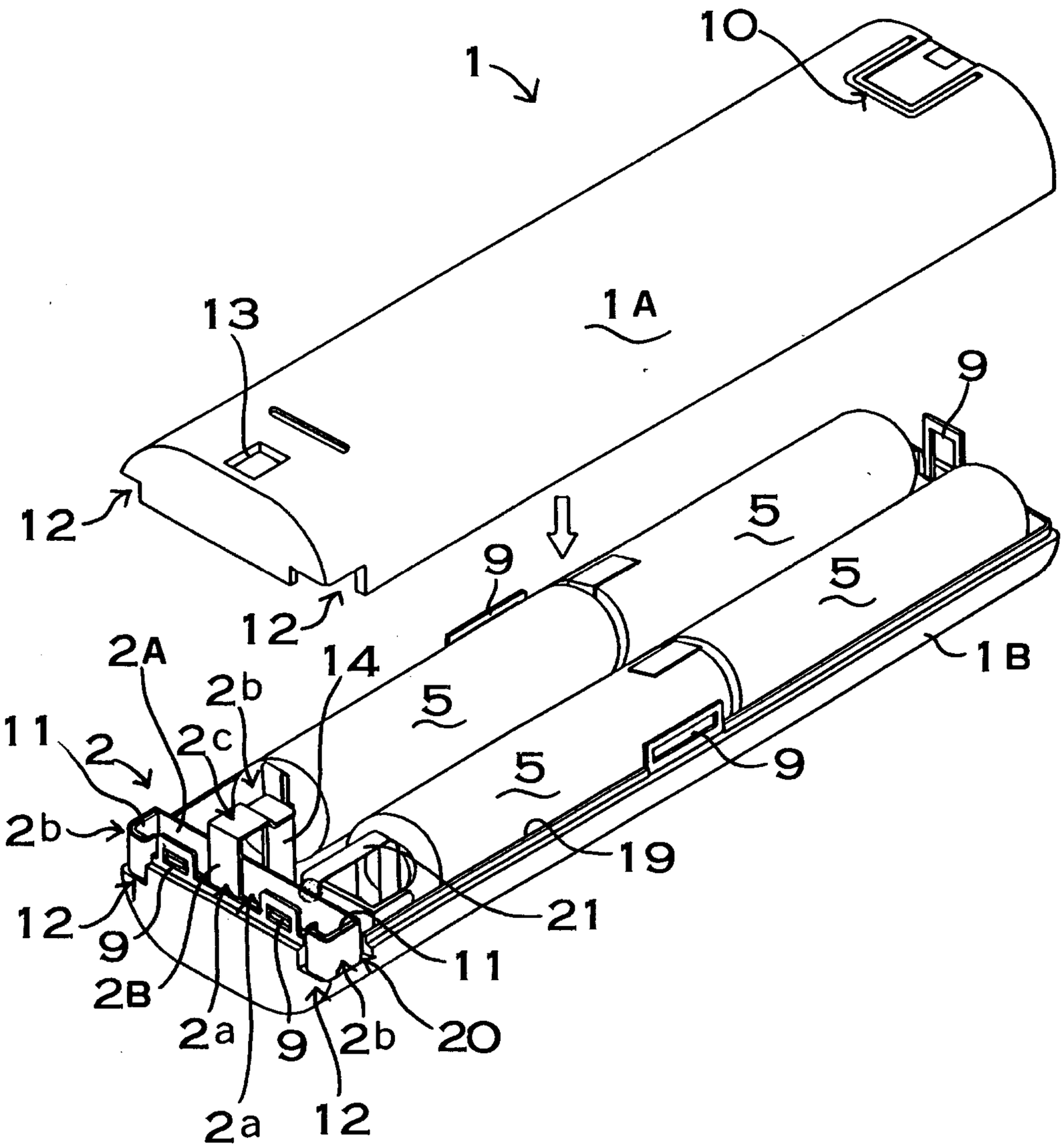

1
10
13
1A
9
12
12
5
5
5
5
9
1B
2A
2b
14
11
2
2c
2b
9
19
21
12
9
11
2B
2a
9
2b
20
2a
12

FIG. 4

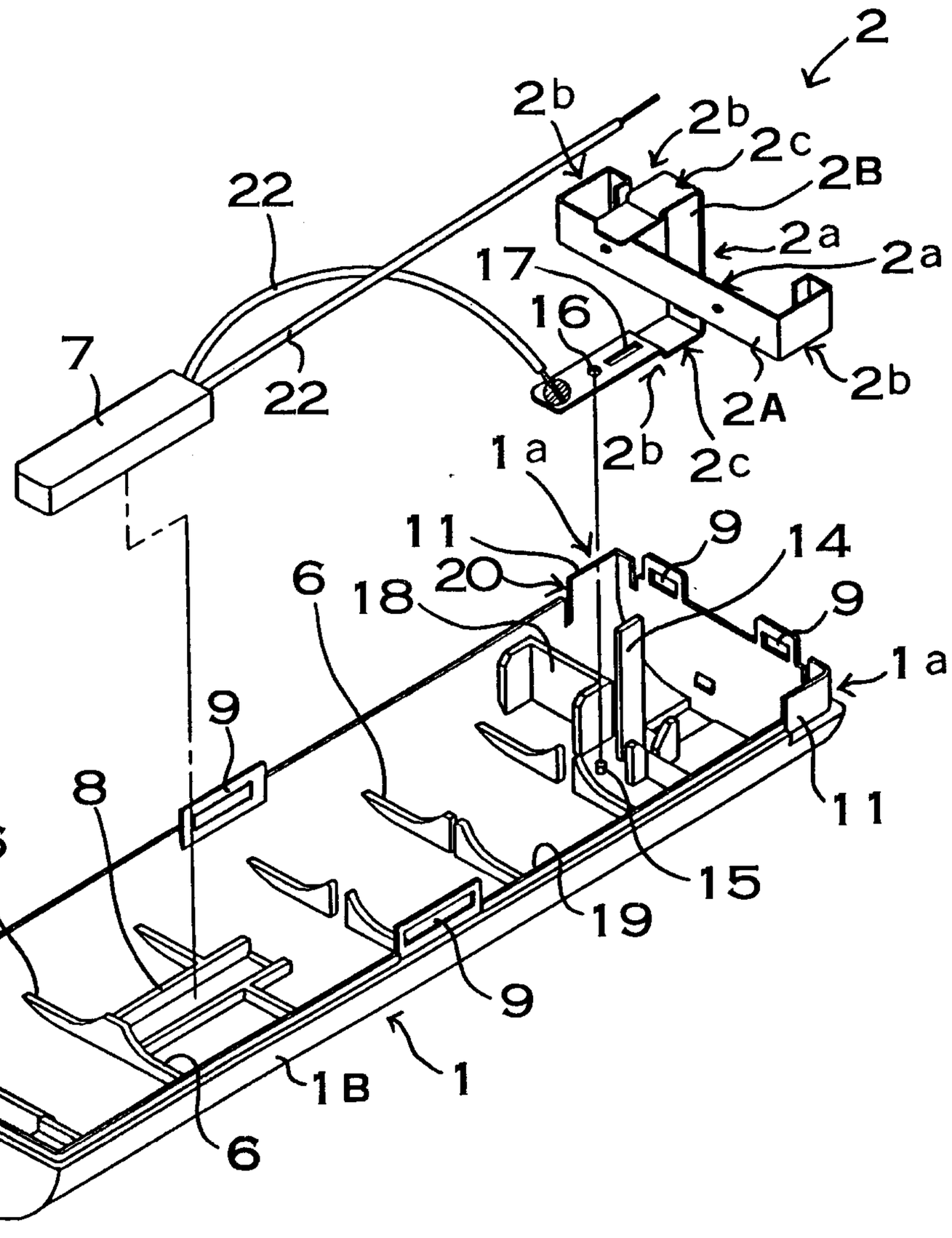

2
2b
2b
2c
2B
22
2a
2a
17
16
7
22
2b
2A
2b
2b
2c
1a
11
9
14
20
18
6
9
1a
9
8
6
11
15
19
9
9
6
1B
1
6

FIG. 5

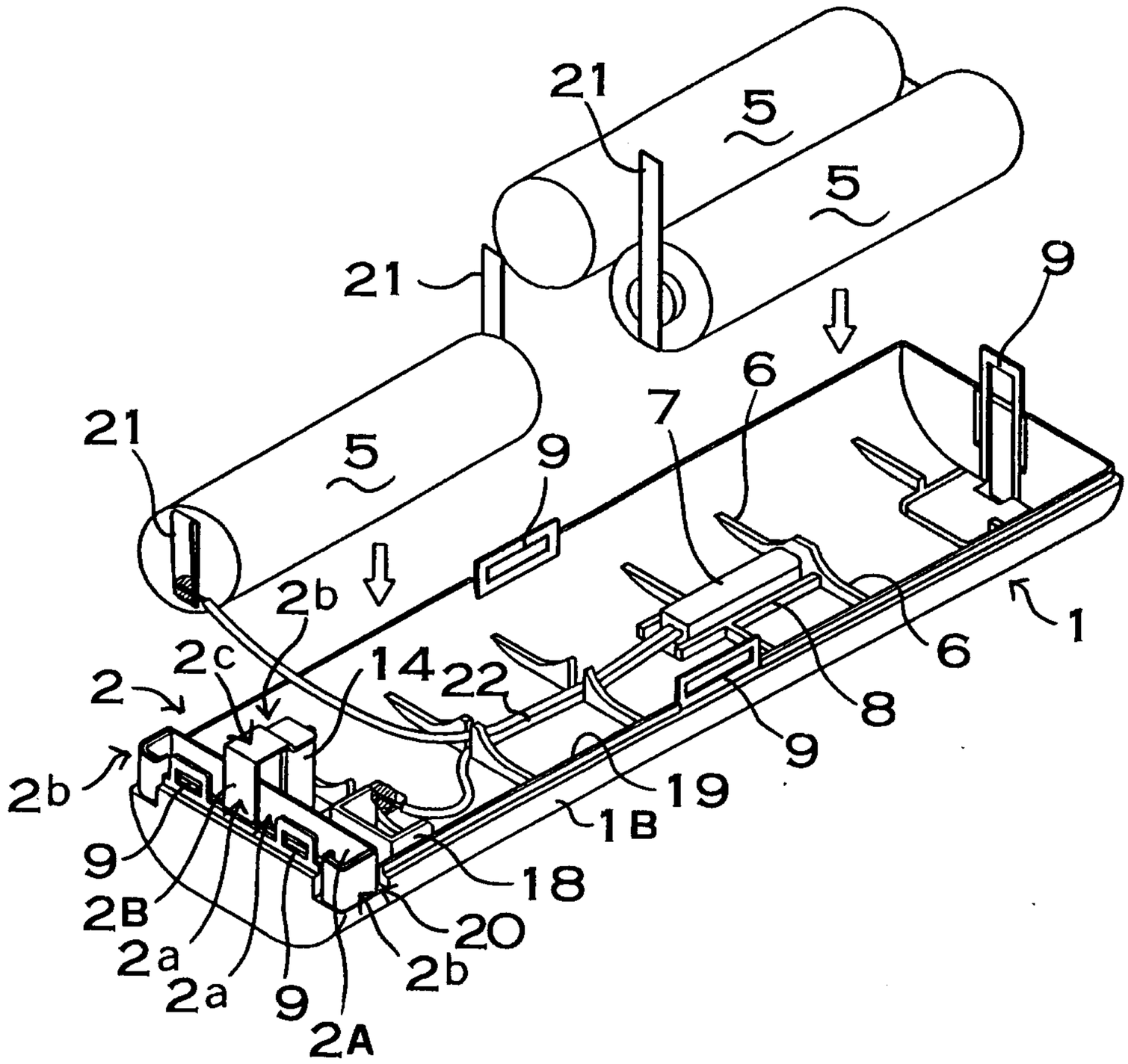

21
5
5
21
9
21
5
9
7
6
2b
2c
14
22
2
6
1
2b
8
9
19
1B
9
18
2B
20
2a
2b
2a
9
2A

FIG. 6

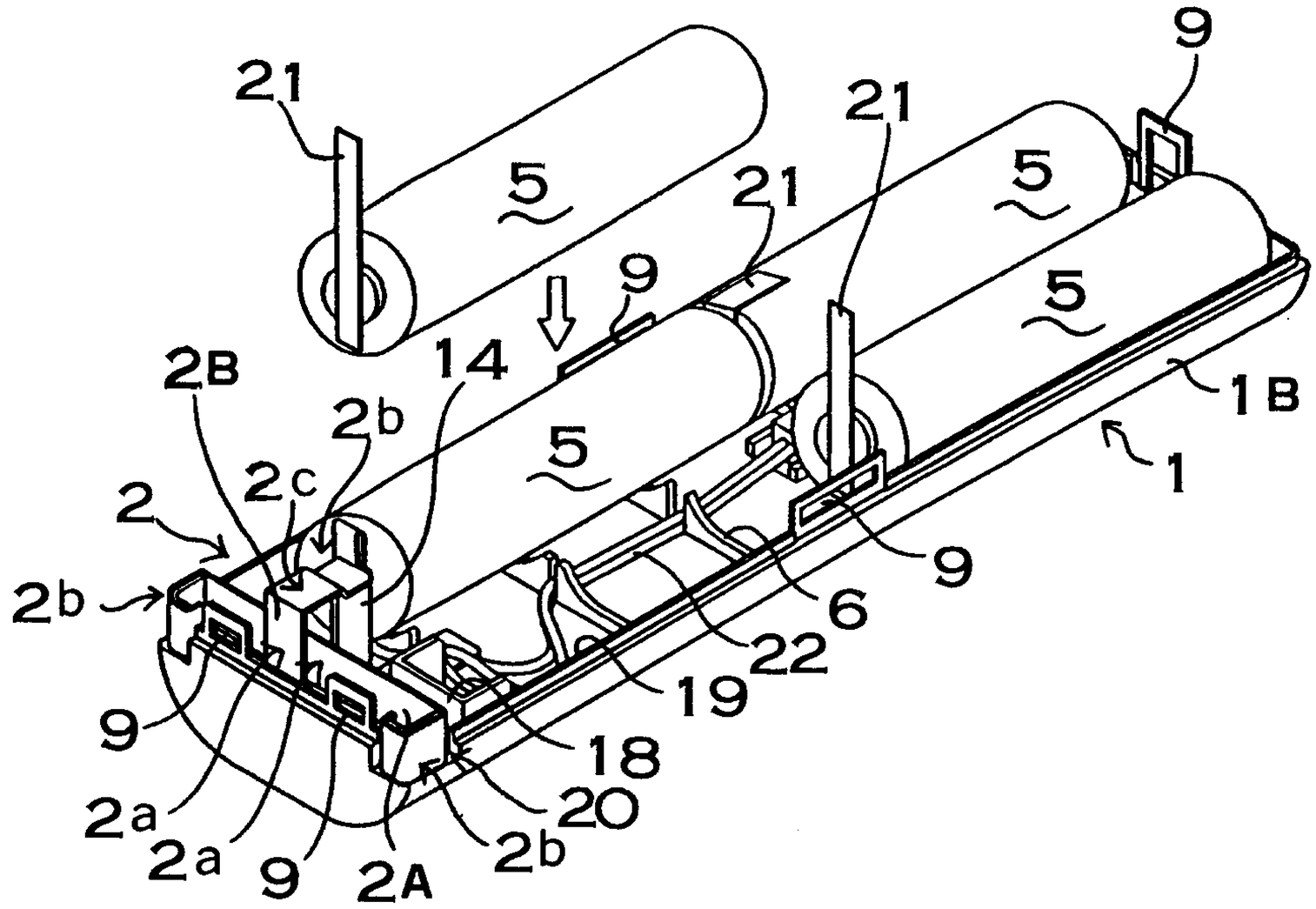

21
5
21
21
5
9
9
14
2B
5
1B
2b
2c
2
1
2b
9
6
22
19
18
2a
20
2a
9
2A
2b

FIG. 7

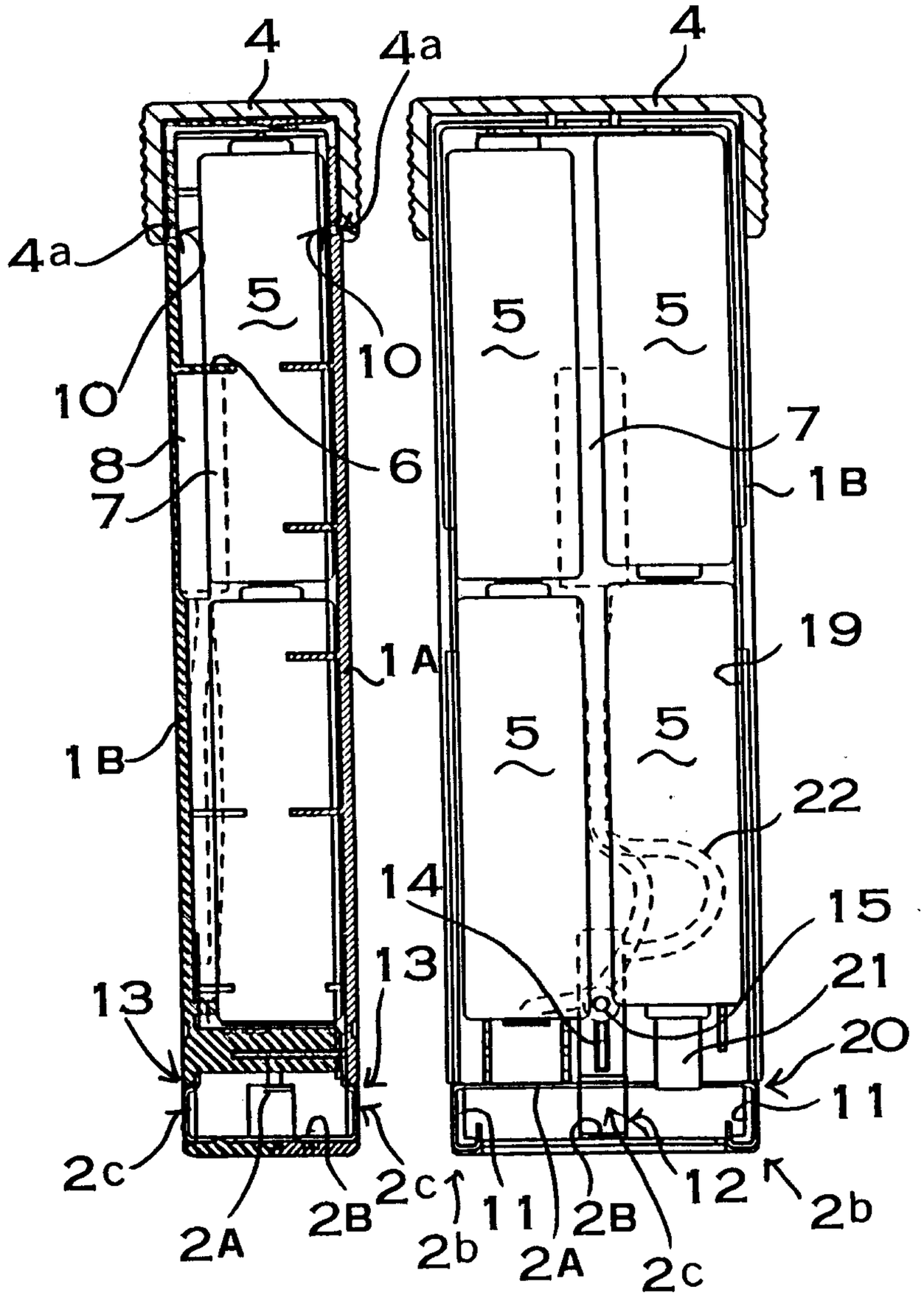

4
4a
4
4a
5
5
5
10
10
7
6
8
7
1B
1A
19
5
5
22
1B
14
15
13
21
13
20
11
2c
2A
2B
2c
2b
11
2B
12
2b
2A
2c

FIG. 8

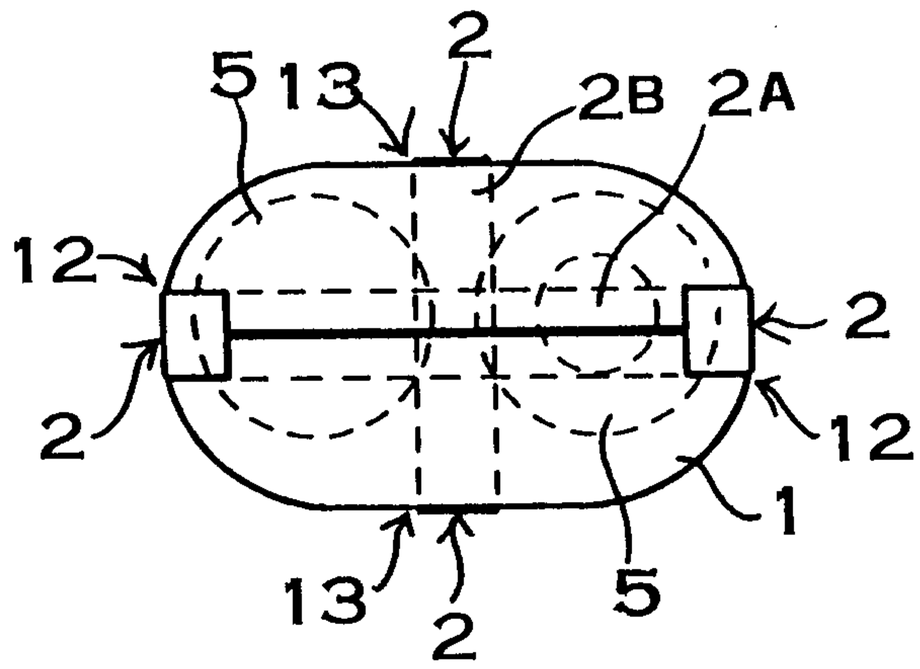

2
5
13
2B
2A
12
2
2
12
1
13
2
5

FIG. 9

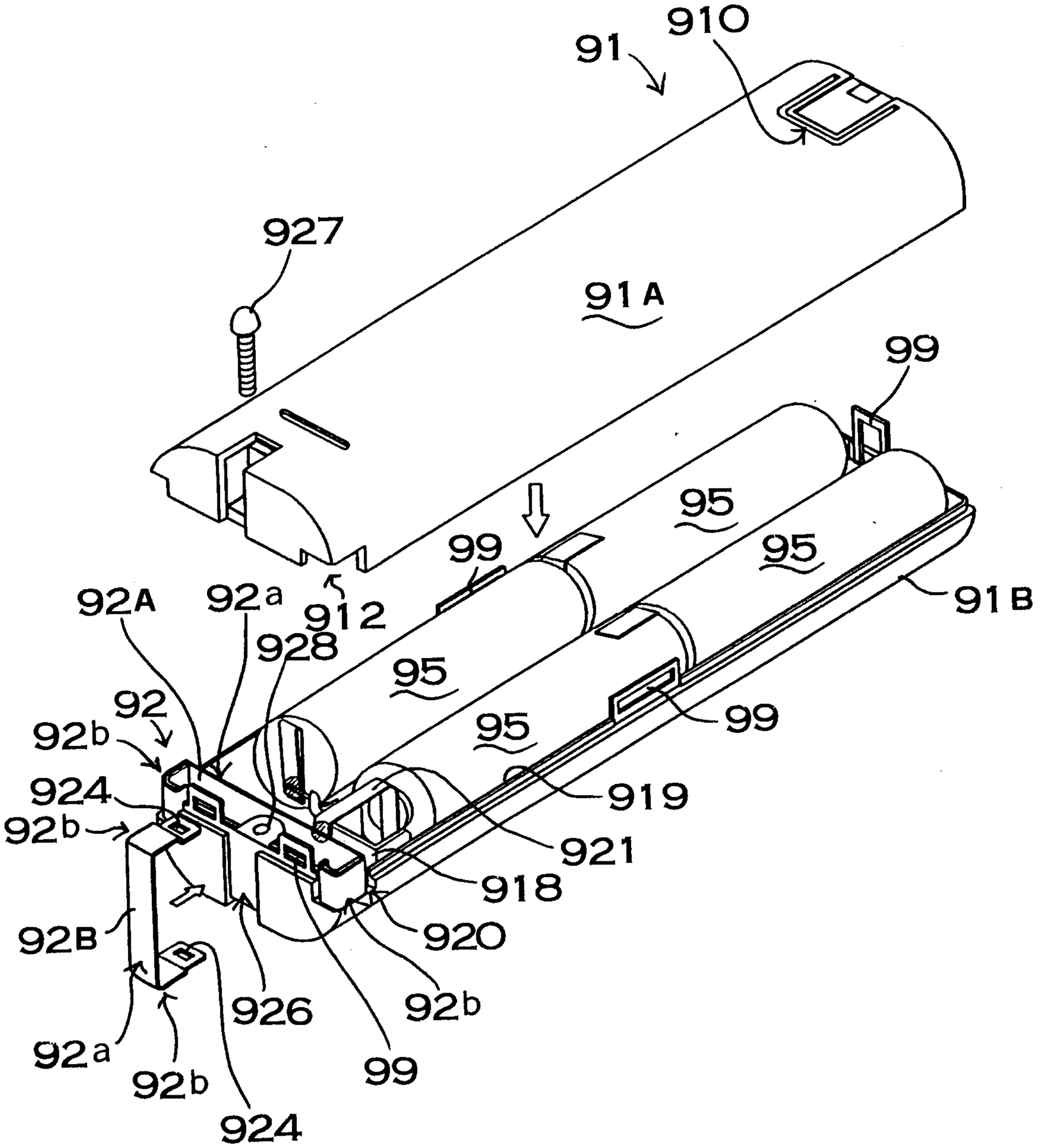

91
910
927
91A
99
95
99
92A
92a
912
928
91B
95
92
92b
95
99
924
919
92b
921
918
92B
920
926
92b
92a
92b
99
924

FIG. 10

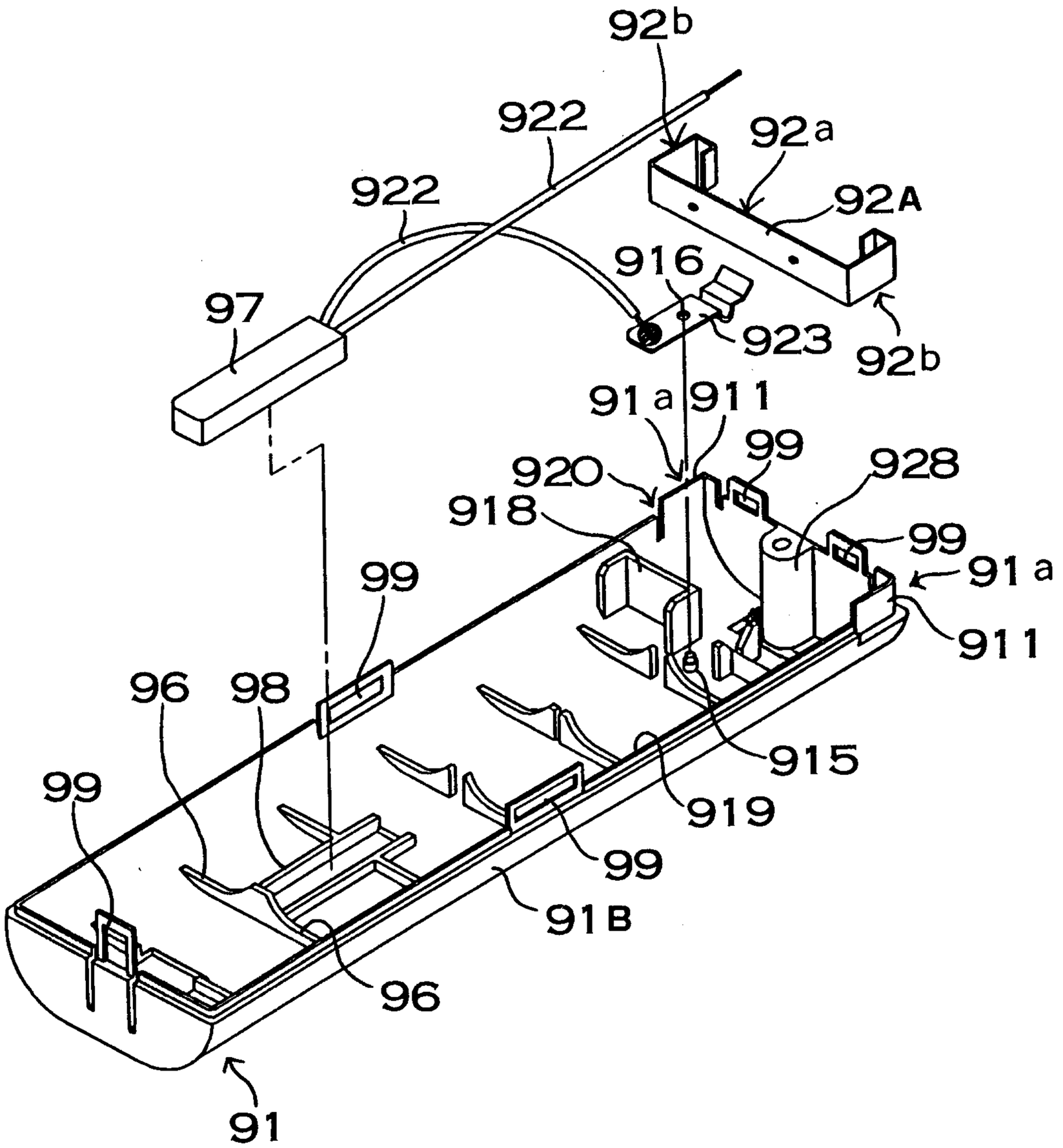

92b
922
92a
922
92A
916
97
923
92b
91a
911
99
920
928
918
99
99
91a
911
96
98
915
99
919
99
91B
96
91

FIG. 11

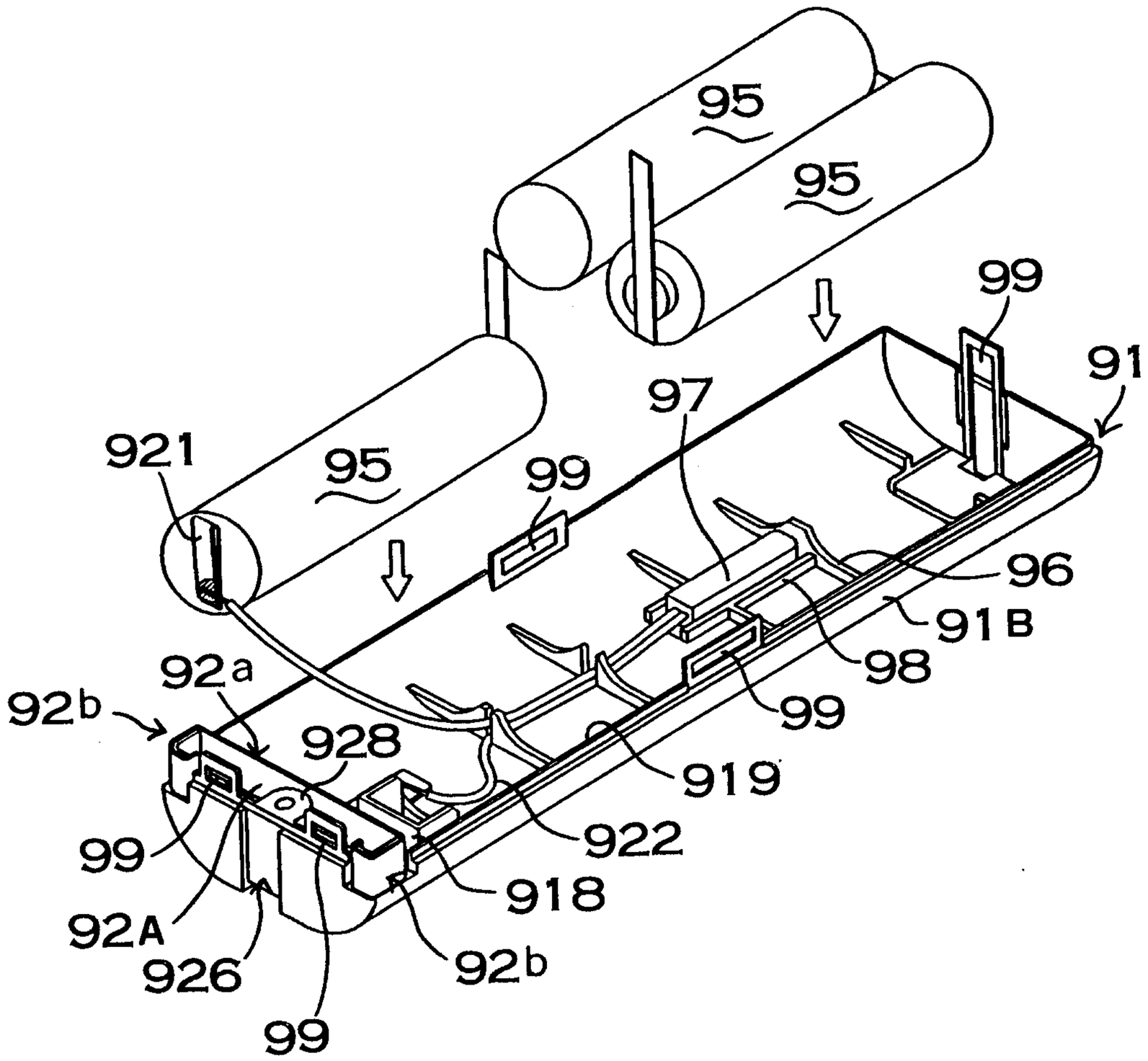

95
95
99
91
97
921
95
99
96
91B
98
92a
92b
928
99
919
922
99
918
92A
926
92b
99

FIG. 12

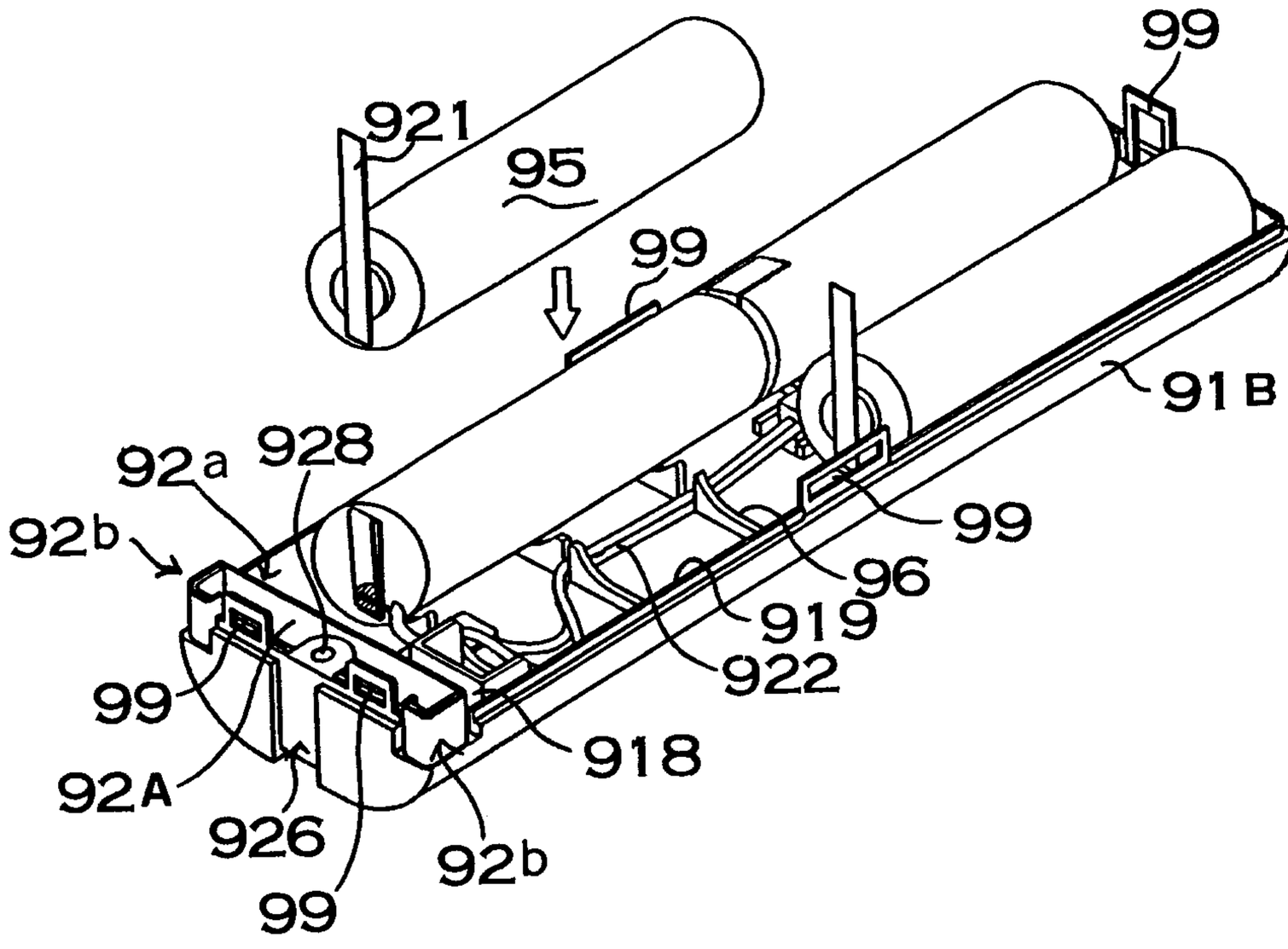

99
921
95
99
91
91B
92a
928
92b
99
96
919
922
99
918
92A
926
92b
99

FIG. 13

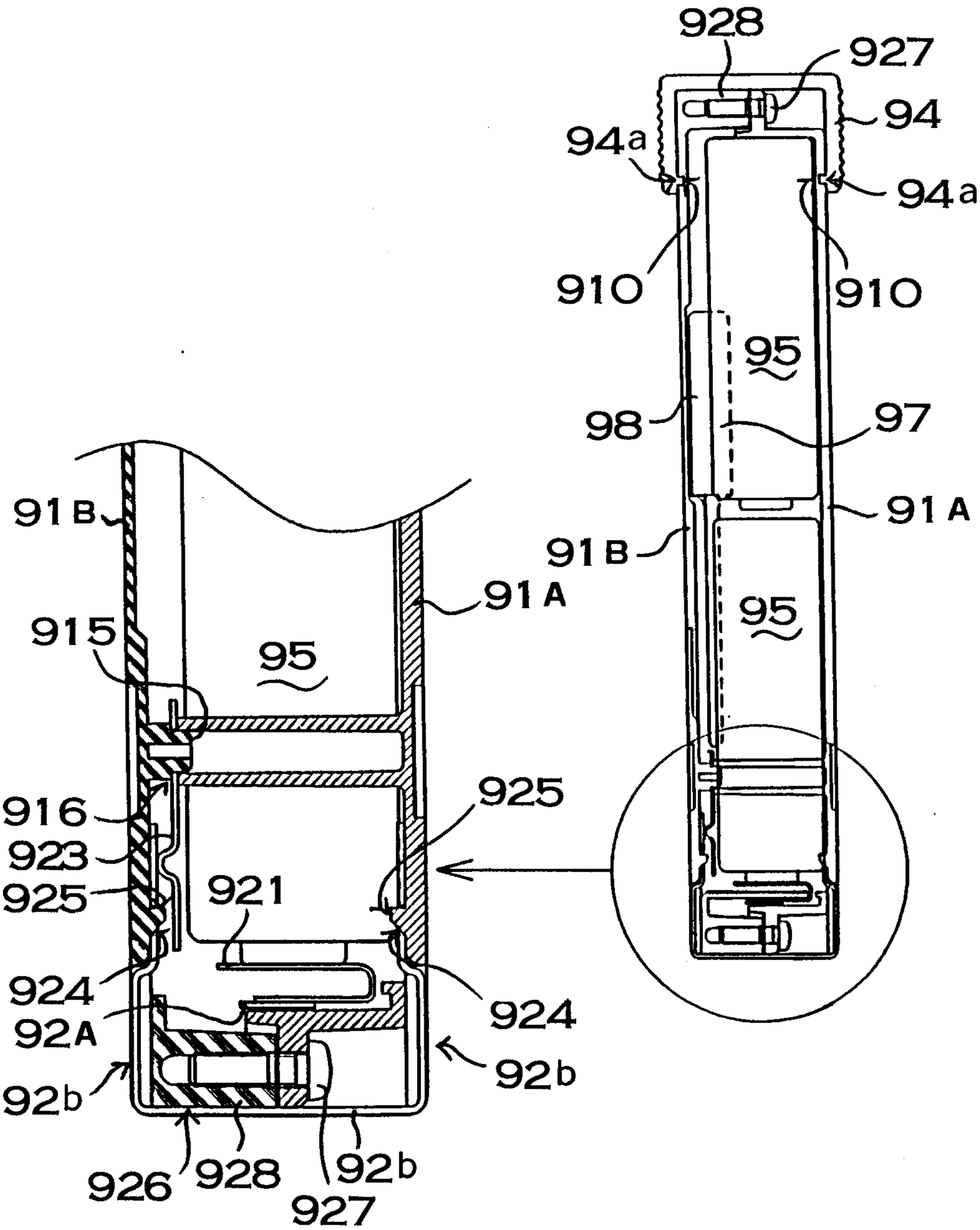
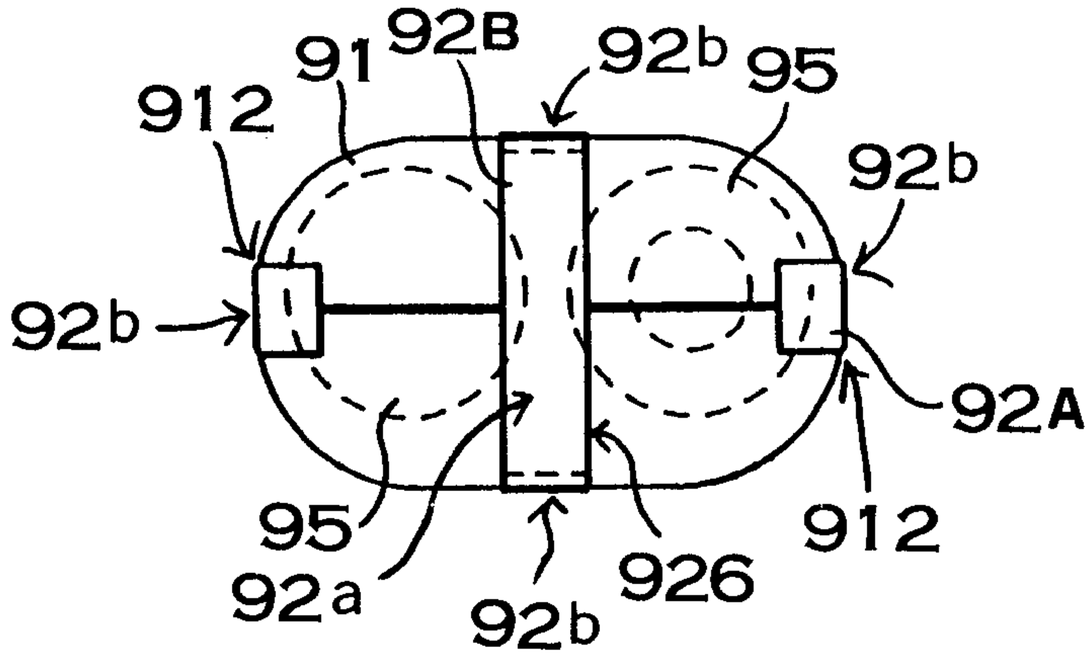

928
927
94
94a
94a
910
910
95
98
97
91A
91B
91B
95
91A
915
95
925
916
923
925
921
924
92A
924
92b
92b
926
928
92b
927

FIG. 14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92B
92b
95
912
92b
92b
92A
95
92a
92b
926
912

FIG. 15

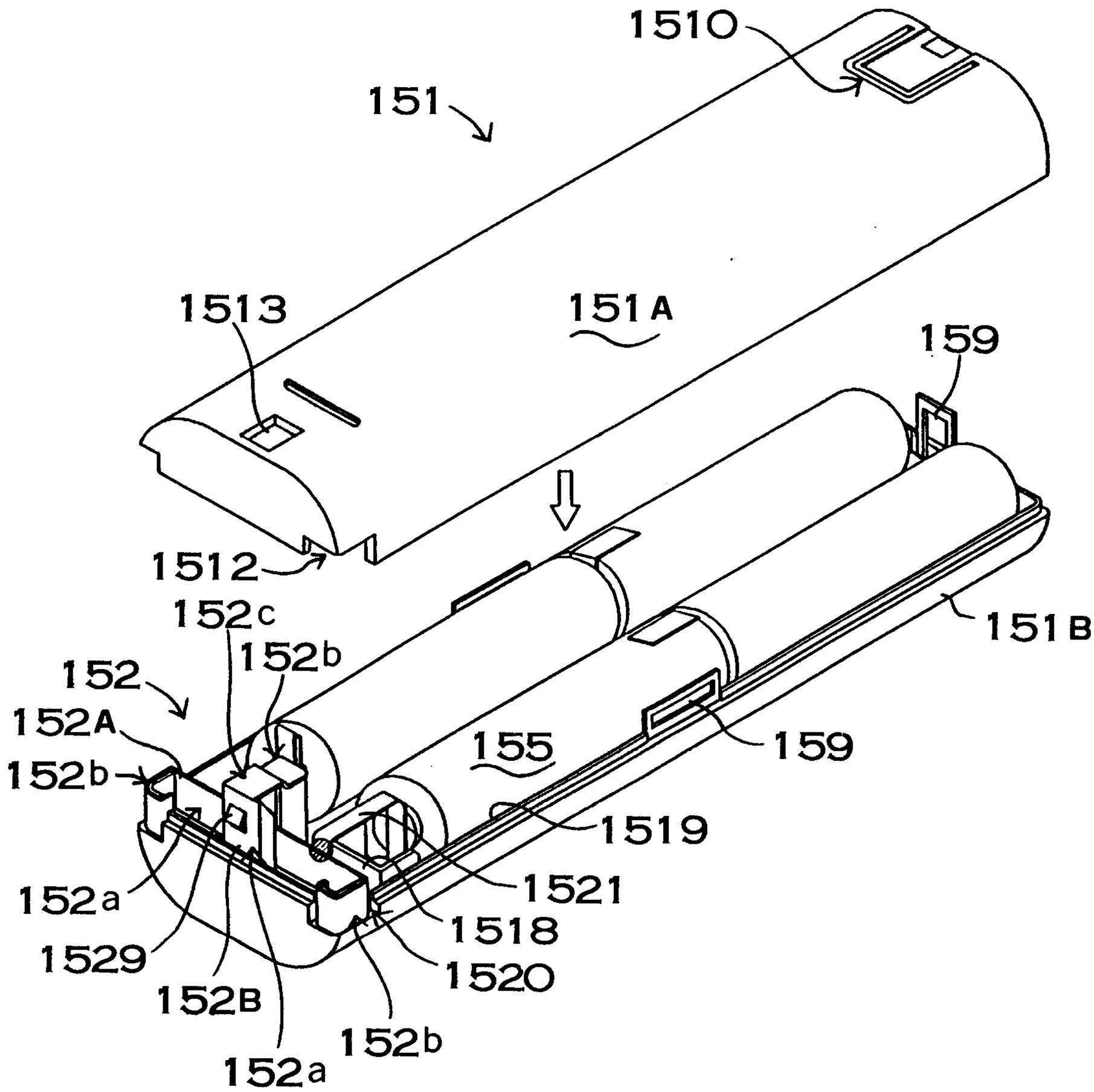

1510
151
1513
151A
159
1512
152c
152b
152
152A
152b
155
159
151B
1519
1521
1518
152a
1529
1520
152B
152b
152a

FIG. 16

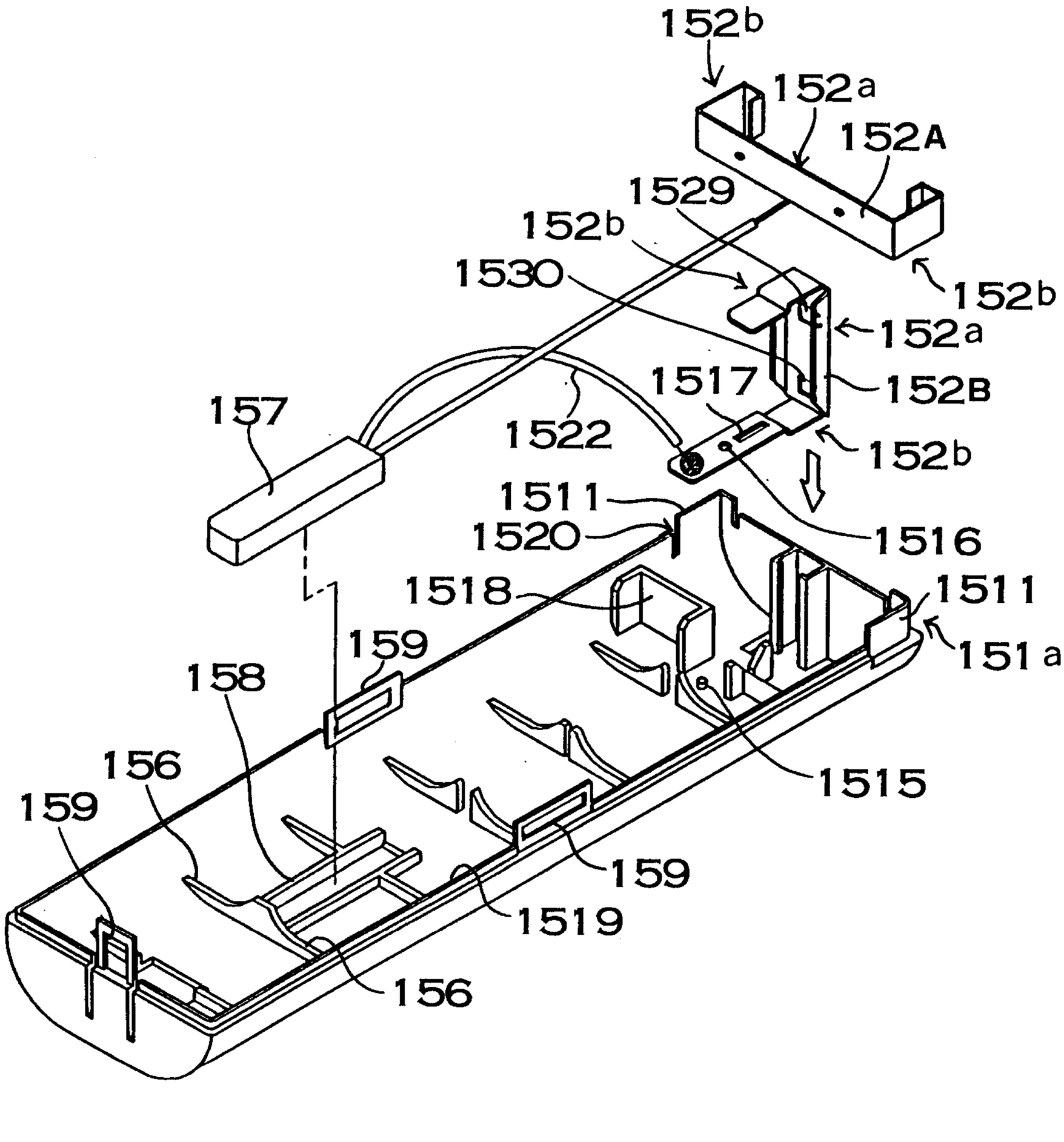

152b
152a
152A
1529
152b
1530
152b
152a
1517
152B
157
1522
152b
1511
1520
1516
1518
1511
151a
159
158
156
159
1515
159
1519
156

FIG. 17

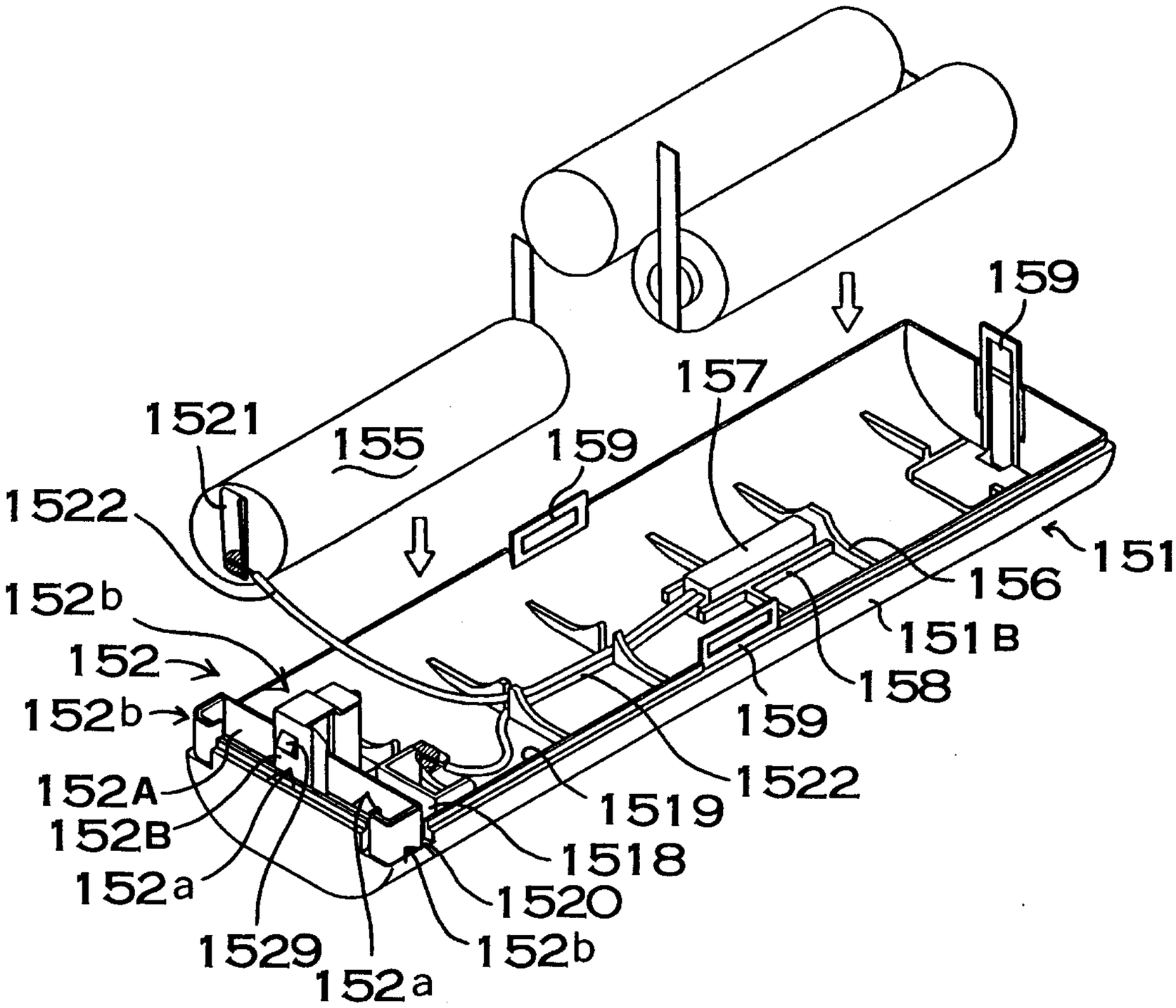

159
157
1521
155
159
1522
151
156
152b
151B
152
158
152b
159
1522
152A
1519
152B
1518
152a
1520
1529
152b
152a

FIG. 18

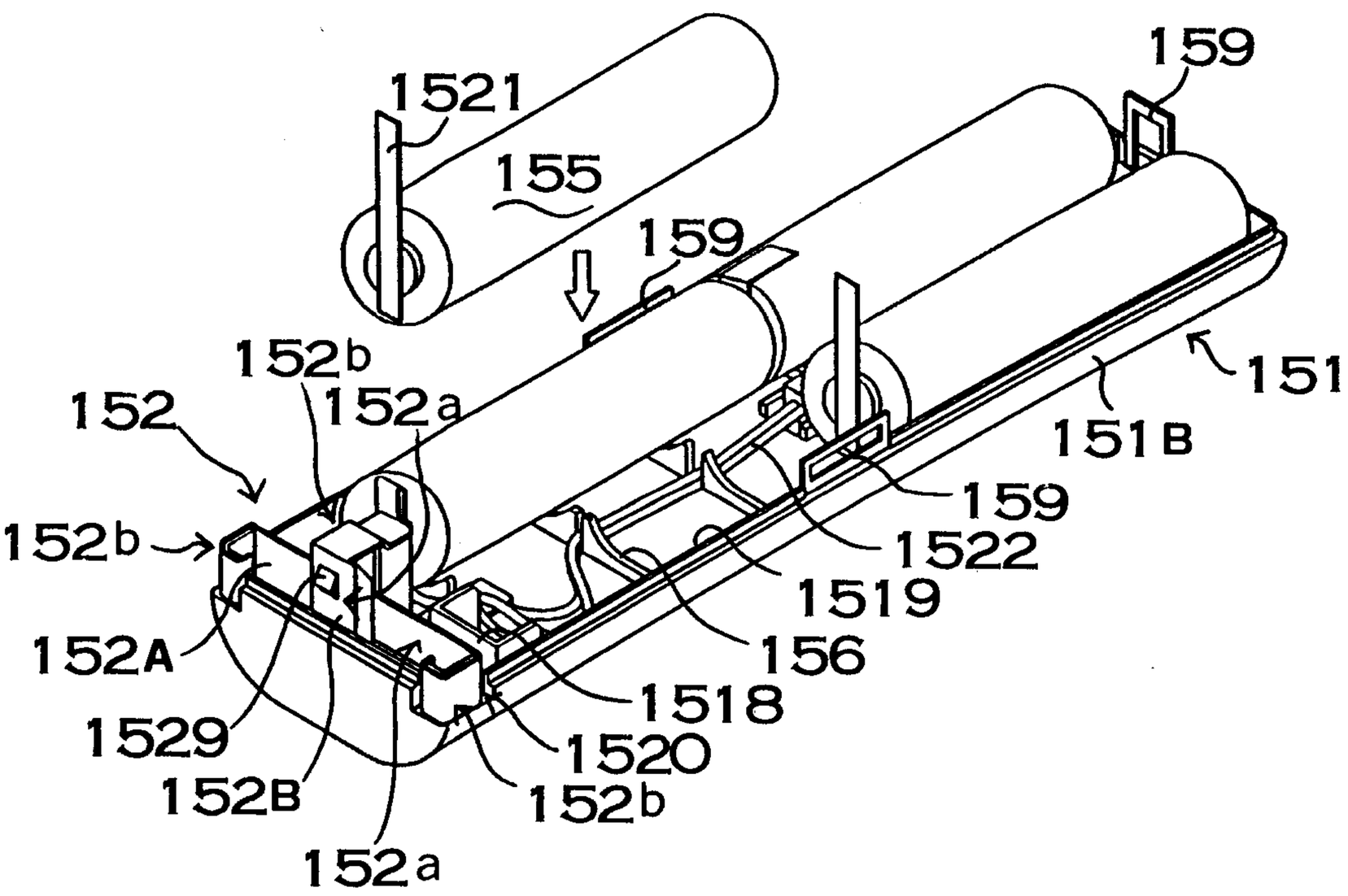
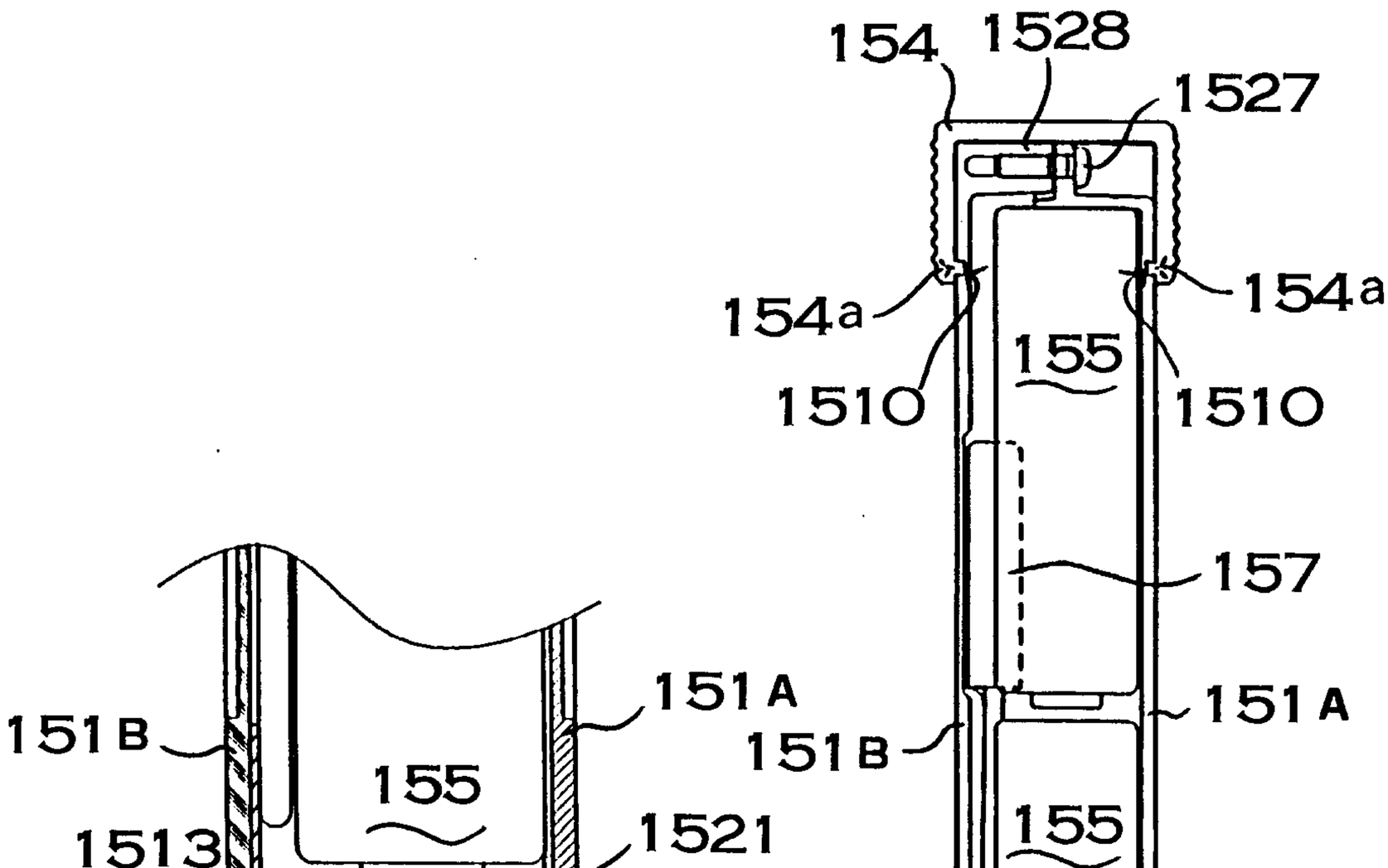

1521
159
155
159
152b
152a
152
151
151B
152b
159
1522
1519
152A
156
1518
1529
1520
152B
152b
152a

FIG. 19


154
1528
1527
154a
154a
155
1510
1510
157
151A
151B
151A
151B
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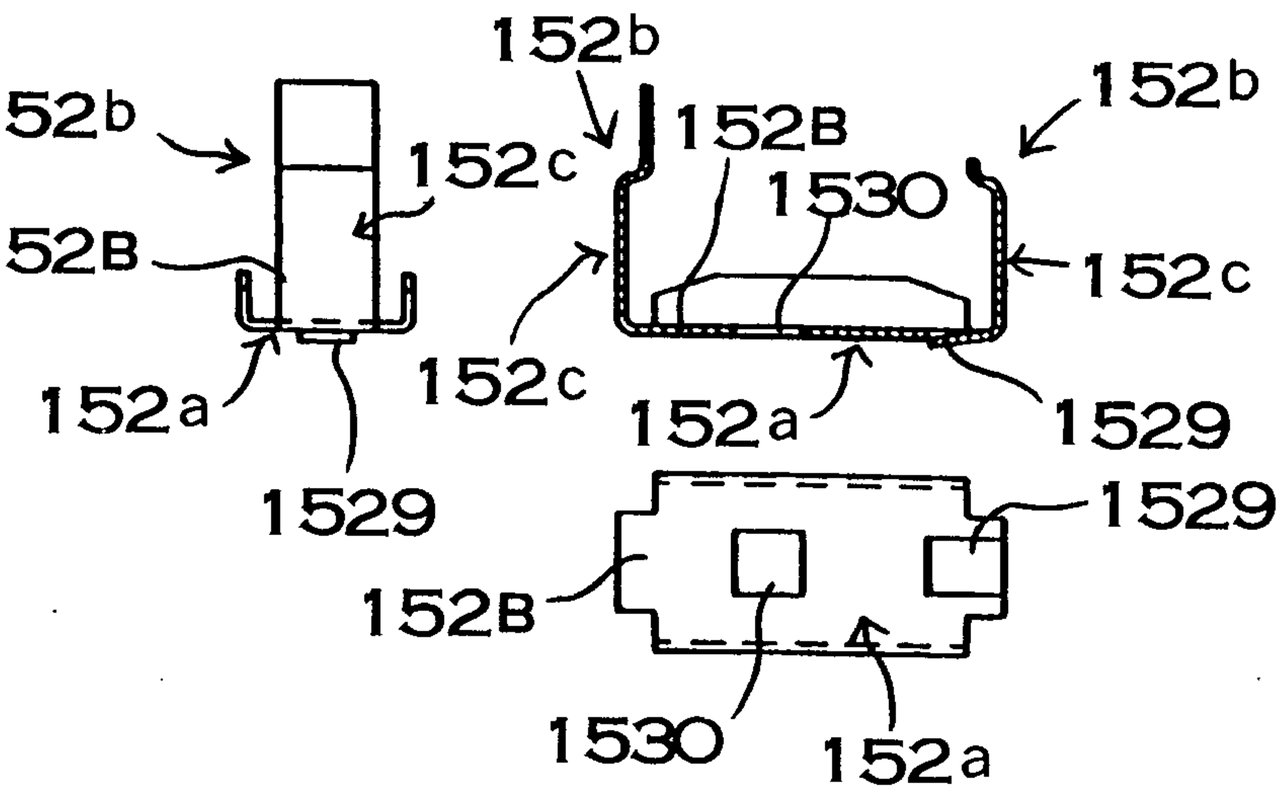
1513
1521
1513
152A
152b
152b
1532
1530
1529
1531
152B

FIG. 20


152b
152b
152B
152b
152c
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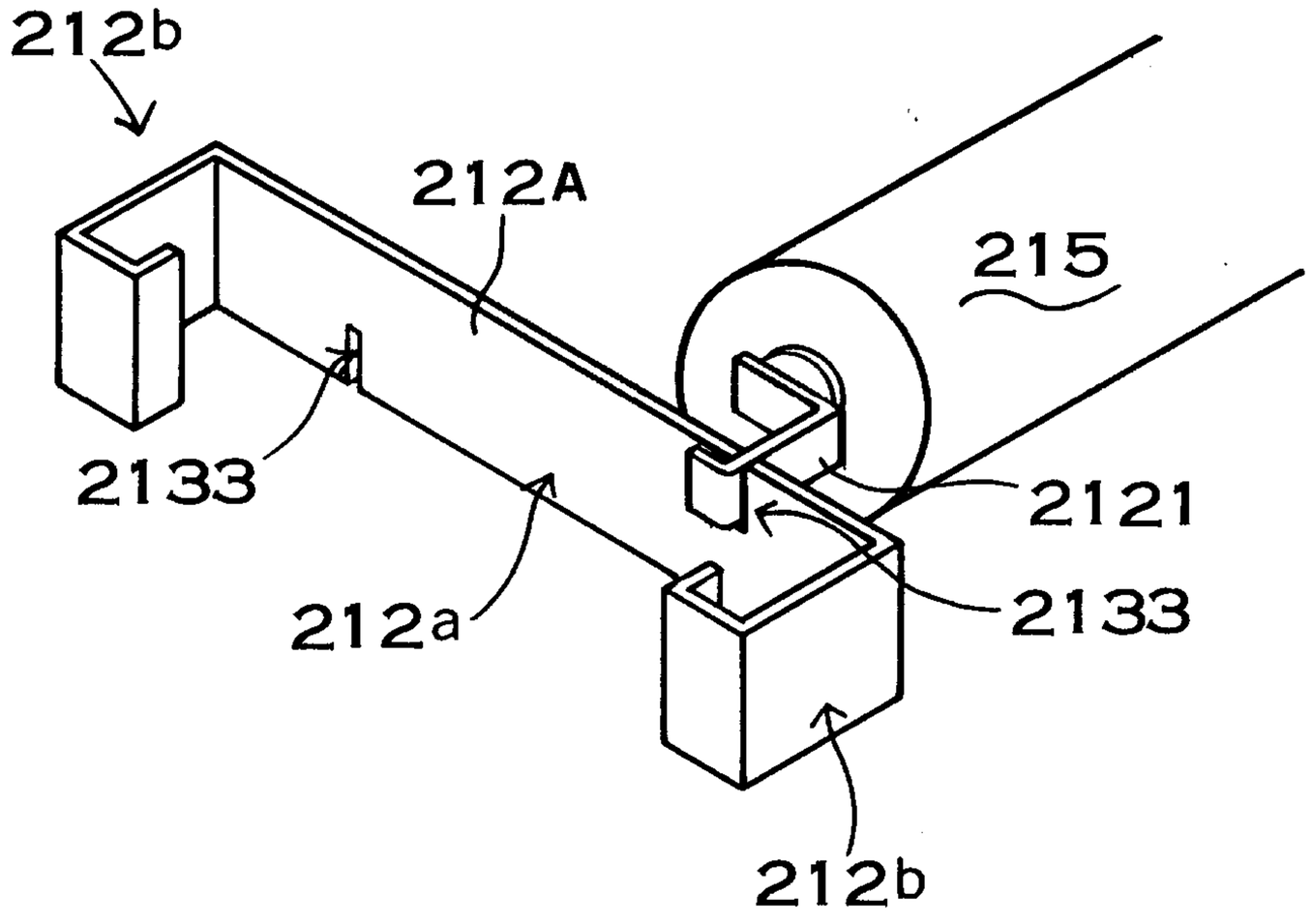
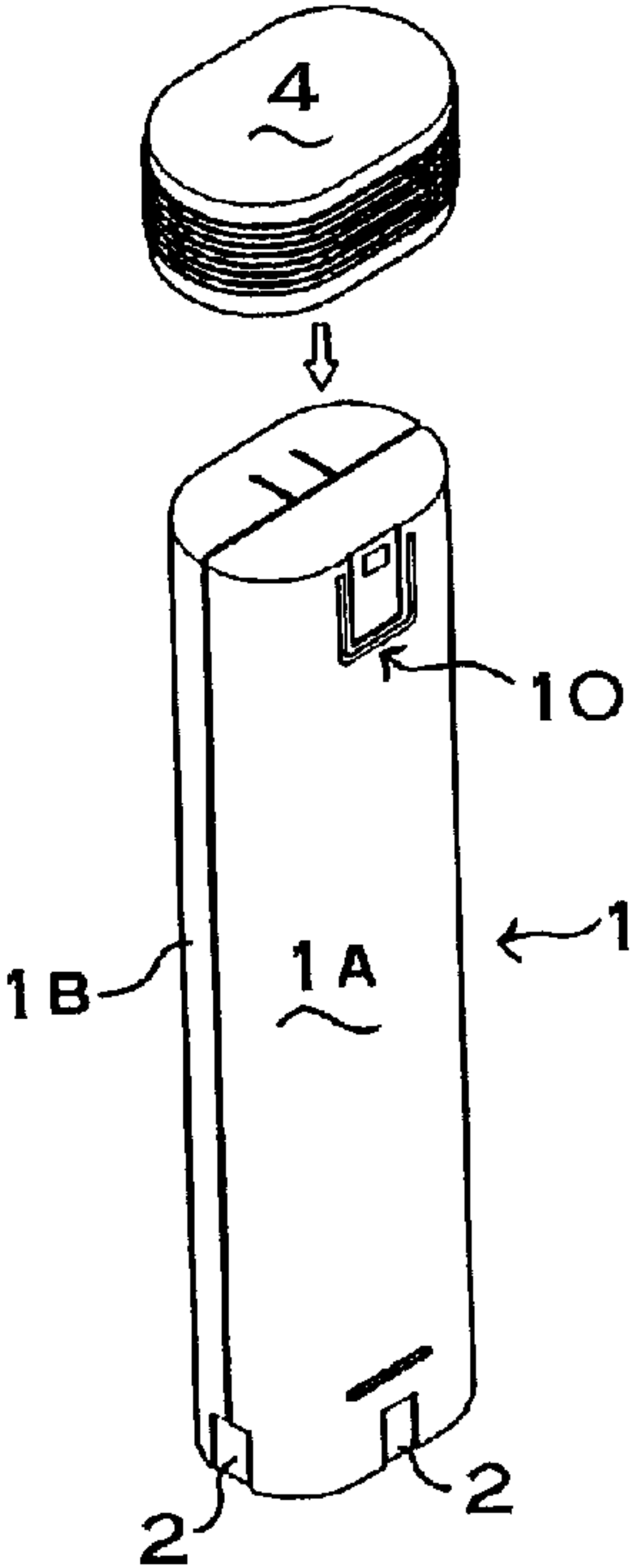
152B
152c
152a
152c
152a
1529
1529
152B
1529
1530
152a

FIG. 21




4
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1
1B
1A
2
2