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(54) **Title:**
CARD CONNECTOR

(57) **Abstract:**
CARD CONNECTOR ABSTRACT OF THE DISCLOSURE A card connector includes a main body having a receiving space, a plurality of terminals attached to the main body, a card locking element, and 5 a card ejecting mechanism. The card locking element includes a locking portion configured to be located in the receiving space when the card locking element is in a locking position, an operating portion, and a first interacting portion. The card ejecting mechanism comprises an actuator movable between an outward position and an inward position and a levering 10 member pivoted adjacent the rear of the receiving space. The actuator includes a second interacting portion configured to engage with the first interacting portion for linked movement of the card locking element and the actuator. The levering member includes a first arm part and a second arm part. The second arm part includes a second end section extending adjacent 15 to the operating portion of the card locking element. The first arm part includes a first end portion that can be swung into the receiving space when the second end section is pushed by the operating portion of the card locking element. The first and second interacting portions allow the movement of the card locking element between the locking position and an 20 unlocking position simultaneous with the movement of the actuator between the outward position and the inward position. Figure 4

CARD CONNECTOR

ABSTRACT OF THE DISCLOSURE

A card connector includes a main body having a receiving space, a plurality of terminals attached to the main body, a card locking element, and a card ejecting mechanism. The card locking element includes a locking portion configured to be located in the receiving space when the card locking element is in a locking position, an operating portion, and a first interacting portion. The card ejecting mechanism comprises an actuator movable between an outward position and an inward position and a levering member pivoted adjacent the rear of the receiving space. The actuator includes a second interacting portion configured to engage with the first interacting portion for linked movement of the card locking element and the actuator. The levering member includes a first arm part and a second arm part. The second arm part includes a second end section extending adjacent to the operating portion of the card locking element. The first arm part includes a first end portion that can be swung into the receiving space when the second end section is pushed by the operating portion of the card locking element. The first and second interacting portions allow the movement of the card locking element between the locking position and an unlocking position simultaneous with the movement of the actuator between the outward position and the inward position.

Figure 4

CARD CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a card connector, and relates more particularly to a SIM (subscriber identity module) card connector.

2. Description of the Related Art

FIG. 1 shows a conventional SIM card connector 1. The SIM card connector 1 has an insulating housing 11 having a card receiving space, a metal shield 16 assembled to the insulating housing 11, a card receiving mechanism 14 insertable into the card receiving space, a pair of elastic pieces 12 having locking portions 121 for retaining the card receiving mechanism 14, a lengthwise arm 13 having two bent flexible arms 132, and a terminal module 15 disposed in the insulating housing 11. The elastic piece 12 generates low retaining force, insufficient to retain the card receiving mechanism 14. To hold the card receiving mechanism 14 more securely, the lengthwise arm 13 is introduced.

The lengthwise arm 13 has two bent flexible arms 132 corresponding to the pair of elastic pieces 12. When the card receiving mechanism 14 is inserted, the card receiving mechanism 14 presses the U-shaped portion of each elastic piece 12 and moves the U-shaped portion of each elastic piece 12 outward. The tip of each elastic piece 12 contacts the respective flexible arm 132 such that additional retaining force is applied to the card receiving mechanism 14. However, the SIM card connector 1 uses too many elastic components to retain the card receiving mechanism 14, consuming too much interior space of the SIM card connector 1 for accommodating these components. In addition, although employing the lengthwise arm 13 can increase retaining force, these elastic components still are not sufficiently strong to firmly hold the card receiving mechanism 14, and are unable to prevent the card receiving mechanism 14 from being accidently removed.

FIGS. 2A and 2B show another conventional SIM card connector 2. The conventional SIM card connector 2 has a housing 20 having an internal housing part for receiving an IC card 22 therein. A slide member 21 having a shaft part slides beside the internal housing part. An eject arm 23 has a shaft hole formed at the center of the eject arm 23. The shaft part of the slide member 21 is fitted into the shaft hole of the eject arm 23 in such a way that allows the eject arm 23 to rotate around the shaft part of the slide member 21. The eject arm 23 has first and second arm parts 23a and 23b extending outward from the disk-like portion of the eject arm 23. The first arm part 23a is provided for engaging the front end of the IC card 22 to rotate the eject arm 23 when the IC card 22 is being inserted. The second arm part 23b has a tip portion having a circular shape for engaging with the concave part 221 formed at one side of the IC card 22.

Because the second arm part 23b is moved by swinging motion, the concave part 221 of the IC card 22 must be made larger so the second arm part 23b does not interfere with the IC card 22 when the IC card 22 is being inserted. However, the large concave part 221 causes an inserted IC card 22 to be loose, as shown in FIG. 2B, and unable to be securely held. In addition, the card ejecting and locking mechanism of the conventional SIM card connector 2 includes too many components and is too complex, resulting in high manufacturing cost.

SUMMARY OF THE INVENTION

In view of the disadvantages of conventional connectors, a new card connector is proposed.

In one embodiment of the present invention, a card connector comprises a main body having a receiving space, a plurality of terminals attached to the main body, a card locking element, and a card ejecting mechanism. The card locking element includes a locking portion, an operating portion, and a first interacting portion. The locking portion is configured to be located in the receiving space when the card locking element is in a locking position. The card ejecting mechanism comprises an

actuator movable between an outward position and an inward position and a levering member pivoted adjacent to the rear of the receiving space. The actuator includes a second interacting portion configured to engage with the first interacting portion for linked movement of the card locking element and the actuator. The levering member includes a first arm part and a second arm part. The second arm part includes a second end section extending adjacent to the operating portion of the card locking element. The first arm part includes a first end portion that can be swung into the receiving space when the second end section is pushed by the operating portion of the card locking element. The first and second interacting portions allow the movement of the card locking element between the locking position and an unlocking position simultaneous with the movement of the actuator between the outward position and the inward position.

In one embodiment of the present invention, a card connector comprises a tray having a notch, a main body having a receiving space for receiving the tray, a plurality of terminals attached to the main body, a card locking element, and a card ejecting mechanism. The card locking element includes a locking portion, an operating portion, and a first interacting portion. The locking portion is configured to be in the notch when the card locking element is in a locking position. The card ejecting mechanism comprises an actuator movable between an outward position and an inward position and a levering member pivoted adjacent to the rear of the receiving space. The actuator comprises a second interacting portion configured to engage with the first interacting portion for linked movement of the card locking element and the actuator. The levering member includes a first arm part and a second arm part. The second arm part includes a second end section extending adjacent to the operating portion of the card locking element. The first arm part includes a first end portion that can be swung into the receiving space when the second end section is pushed by the operating portion of the card locking element. The first and second interacting portions allow the movement of the card locking element between the locking position and an unlocking position simultaneous with

the movement of the actuator between the outward position and the inward position.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described according to the appended drawings in which:

FIG. 1 shows a conventional SIM card connector;

FIGS. 2A and 2B show another conventional SIM card connector;

FIG. 3 is a perspective view showing a card connector, an electrical card and a tray according to one embodiment of the present invention;

FIG. 4 is an exploded perspective view showing a card connector according to one embodiment of the present invention;

FIG. 5 is a perspective view showing the status of the levering member and the card ejecting mechanism of a card connector when no tray is inserted according to one embodiment of the present invention;

FIG. 6 is a top view of the embodiment of FIG. 5;

FIG. 7 is an exploded perspective view with the parts separated of the embodiment of FIG. 5;

FIG. 8 is a perspective view showing a tray inserted into an electrical card connector according to one embodiment of the present invention;

FIG. 9 is a top view of the embodiment of FIG. 8;

FIG. 10 is a perspective view showing a card connector with an inserted tray according to one embodiment of the present invention;

FIG. 11 is a top view of the embodiment of FIG. 10;

FIG. 12 is a view showing a tray being rejected from a card connector by a rod member according to one embodiment of the present invention;

FIG. 13 is a top view of the embodiment of FIG. 12;

FIG. 14 is a perspective view showing a card connector and a tray carrying an electrical card according to one embodiment of the present invention; and

FIG. 15 shows an electrical card connector inserted with an empty tray according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, embodiments of the present invention are described in detail with reference to the attached drawings.

FIG. 3 is a perspective view showing a card connector 3, an electrical card 4 and a tray 5 according to one embodiment of the present invention. FIG. 4 is an exploded perspective view showing a card connector 3 according to one embodiment of the present invention. Referring to FIGS. 3 and 4, the card connector 3 comprises a cover member 31, a main body 32 covered by the cover member 31 and formed with a receiving space 321, a plurality of terminals 33 attached to (for example, insert molded with) the main body 32, a card locking element 34 including a locking portion 341 configured to be located in the receiving space 321 when the card locking element 34 in a locking position, and a card ejecting mechanism 35 including an actuator 351 movable in a back and forth direction and a levering member 352 mounted adjacent to the rear of the receiving space 321. The card connector 3 can receive a tray 5 carrying an electrical card 4, and can be mountable on a printed circuit board 6. The assembled cover member 31 and main body 32 form a front opening 36 through which the electrical card 4 or the tray 5 is inserted.

In one embodiment, the card locking element 34 is rigid, not elastic, so that an inserted tray 5 can be firmly held.

Referring to FIGS. 4 to 7, the levering member 352, pivoted on a pivot 322, comprises a first arm part 3521 and a second arm part 3522. The first arm part 3521 extends transversely at the rear of the main body 32 and includes a first end portion 35211 having a push tab 35212 that extends upward and can be swung into the receiving space 321 to eject an inserted tray 5. The second arm part 3522 can extend beside the receiving space 321, including a second end section 35221 having a tab portion 35222.

As shown in FIGS. 6, 7, 9 and 13, the main body 32 includes a recessed area 323 transversely extending on the main body 32. A bottom portion of the recessed area 323 extends under the receiving space 321. The bottom of the locking portion 341 is received in the recessed area 323. As such, the movement of the locking portion 341 between a locking position as shown in FIG. 6 and an unlocking position as shown in FIG. 9 or FIG. 13 is confined by the recessed area 323. In another embodiment, the main body 32 does not have a recessed area 323 for receiving the bottom of the locking portion 341.

In particular, the locking portion 341 includes a front corner and a rear corner both formed on the peripheral surface of the locking portion 341. The front corner is a cut corner or a round corner so that when the tray 5 engages the front corner of the locking portion 341, the tray 5 can easily move along the front corner. The rear corner is a cut corner or a round corner so that when the tray 5 is moved outward, the tray 5 can easily move along the rear corner.

The card locking element 34 further comprises an operating portion 342 extending toward the second arm part 3522 and engaging with the second arm part 3522 for linked movement therewith. Specifically, the operating portion 342 includes a side 3421 opposite the receiving space 321, and the tab portion 35222 of the second arm part 3522 extends adjacent to

the side 3421 of the operating portion 342 such that when the locking portion 341 is moved toward the unlocking position, the operating portion 342 can push the tab portion 35222 of the second arm part 3522 to rotate the levering member 352. In particular, the operating portion 342 has a rectangular cross section, and the tab portion 35222 of the second end section 35221 is bent downward to form an L-shape such that the second end section 35221 extends around the outside upper corner of the operating portion 342.

In addition, a groove 3422 is formed on the bottom of the operating portion 342, and an elongated projection 327 is correspondingly formed on the main body 32, mated with the groove 3422, and extending along the recessed area 323. The elongated projection 327 passes through the groove 3422 when the card locking element 34 is assembled to the main body 32. The cooperation between the groove 3422 and the elongated projection 327 can further constrain or guide the movement of the card locking element 34.

Furthermore, the card locking element 34 comprises a plate portion 344 movable within a space defined by a bottom surface of the main body 32 and the actuator 351. The plate portion 344 facilitates the proper movement of the card locking element 34.

Referring to FIGS. 7 and 8 to 11, the actuator 351 is movable between an outward position as shown in FIGS. 10 and 11 and an inward position as shown in FIGS. 8 and 9 along a direction parallel to the insertion direction of the tray 5. The actuator 351 can move the card locking element 34. The card locking element 34 comprises a first interacting portion 343, and the actuator 351 comprises a second interacting portion 3511. The first and second interacting portions 343 and 3551 are engaged for linked movement of the card locking element 34 and the actuator 351, allowing the movement of the card locking element 34 between the locking position and the unlocking position simultaneous with the movement of the actuator 351 between the outward position and the inward position. The interaction of the first and second interacting portions 343 and 3551 can cause the card

locking element 34 and the actuator 351 to move in different directions, for example, two perpendicular directions.

As shown in FIG. 7, in one embodiment, the first interacting portion 343 of the card locking element 34 comprises a pin, and the second interacting portion 3511 of the actuator 351 comprises a slot inclined at an angle, such as 45 degrees, relative to the moving direction of the actuator 351. The slot has two elongated slot edges. When the actuator 351 is moved, one elongated slot edge contacts the pin, pushing the pin to move along the same elongated slot edge so as to move the card locking element 34. Alternatively, when the pin is moved, the pin pushes another elongated slot edge, moving along the same elongated slot edge so as to move the actuator 351. In one embodiment, the pin can have an elliptic cross section.

The actuator 351 can have a plate-like shape, confined in a concave space 325, and moving over a platform 324. The actuator 351 can further have a bent end 3512 restrained in a recessed area 326 included in the main body 32 and disposed adjacent to the front of the main body 32 such that the movement of the actuator 351 can be restricted.

Referring to FIGS. 7 to 11, the card connector 3 further comprises an elastic member 37. The elastic member 37 provides an elastic force counteracting a force moving the actuator 351 inward, and moves the actuator 351 outward when the force is removed. In one embodiment, the elastic member 37 comprises a spring.

In particular, a channel 328 is formed on the platform 324, communicating with the recessed area 326. A supporting member 38 is provided at the end of the channel 328 for engaging with an end of the elastic member 37. The supporting member 38 can have a pin configured to protrude into the elastic member 37. Another end of the elastic member 37 engages the bent end 3512 of the actuator 351.

FIGS. 8 to 11 are used herein to demonstrate the operation of the card locking element 34 and the card ejecting mechanism 35 during the insertion

of a tray 5 carrying an electrical card 4. The operation is similar when a single, different size of electrical card is inserted. As shown in FIGS. 8 and 9, after the inserting tray 5 contacts the locking portion 341 of the card locking element 34, the locking portion 341 is pushed and the card locking element 34 is moved away from the receiving space 321 until the tip of the locking portion 341 is against the right edge of the tray 5. During the movement of the card locking element 34, the first interacting portion 343 of the card locking element 34, which is a pin in the present embodiment, pushes one elongated slot edge, close to the levering member 352, of the second interacting portion 3511, a slot in the present embodiment, and moves along the same slot edge such that the actuator 351 is moved inward and the elastic member 37 is compressed.

Referring to FIGS. 10 and 11, when the rear edge of the tray 5 is close to the rear of the main body 32, the rear edge touches the first arm part 3521 of the levering member 352 and rotates the levering member 352 until the tray 5 is completely inserted. At some moment during the insertion process, the notch 52 of the tray 5 encounters the locking portion 341 of the locking element 34. The locking element 34 is moved toward the notch 52 due to the elastic force produced by the compressed elastic member 37. Without the counterforce from the right edge of the tray 5 to the locking element 34, the elastic force produced by the compressed elastic member 37 moves the actuator 351 and the elongated slot edge, close to the levering member 352, of the second interacting portion 3511 pushes the first interacting portion 343 of the card locking element 34, applying a force, a portion of which moves the locking element 34 toward the receiving space 321 until the locking portion 341 of the locking element 34 enters the notch 52. Because the locking portion 341 of the locking element 34 moves into and away from the receiving space 321 linearly, the notch 52 and the locking portion 341 can be fitted closely to each other so that the tray 5 can be securely held after it is inserted.

Referring to FIGS. 10, 12 and 13, the main body 32 has an opening 329

formed on a front side wall of the main body 32 to expose the bent end 3512 of the actuator 351. The tray 5 has a bar member 53 defining a side of the receiving space 321. A hole 51 is formed on the bar member 53, corresponding to the opening 329 of the main body 32. To eject the tray 5, a rod member 41 is inserted into the opening 329 and the hole 51, and pushes the actuator 351. The actuator 351 is moved inward, compressing the elastic member 37. Simultaneously, the elongated slot edge of the second interacting portion 3511 of the actuator 351 pushes the first interacting portion 343 of the card locking element 34 and moves the card locking element 34 away from the receiving space 321; meanwhile, the operating portion 342 of the card locking element 34 pushes the tab portion 35222 of the levering member 352, rotating the levering member 352. The push tab 35212 of the first arm part 3521 of the rotating levering member 352 pushes the rear edge of the tray 5 outward. As the locking portion 341 of the card locking element 34 disengages from the notch 52 of the tray 5, the tray 5 is moved outward until the first interacting portion 343 is moved to the end of the second interacting portion 3511, close to an external side wall of the main body 32.

Referring to FIGS. 7, 14 and 15, the card connector 3 further comprises a detective member 39 and a detective contact 40. The detective contact 40 is attached to the main body 32 and solderable to the printed circuit board 6. The detective member 39 is elastically deformable, having a touch portion 392 protruding into the receiving space 321 for engaging with an inserted electrical card 4 carried by the tray 5, one end portion 391 configured to be held by the main body 32 and solderable to the printed circuit board 6, and another end portion 393 configured to contact the detective contact 40 when the detective member 39 is not deformed. The tray 5 has a card-holding space 54 surrounded by a side wall 55. A breach 56 is formed on the side wall 55, corresponding to the touch portion 392, and configured to prevent the touch portion 392 of the detective member 39 from interfering with an inserted empty tray as shown in FIG. 15. As shown in FIGS. 10 and 11, when a tray 5 carrying an electrical card 4 is inserted, the inserted electrical

card 4 pushes the touch portion 392 of the detective member 39, deflecting the detective member 39 outward, disengaging the end portion 393 of the detective member 39 from the detective contact 40.

Although the card locking element 34 and the card ejecting mechanism 35 are applied, in the above embodiments, in a card connector 3 receiving a tray, the same card locking element 34 and card ejecting mechanism 35 can also be employed in a card connector directly receiving a card according to another embodiment of the present invention.

In one embodiment, a card connector comprises a card locking element for latching an inserted tray receiving an electrical card and a card ejecting mechanism for facilitating the movement of the card locking element between a locking position and an unlocking position. The card locking element can be rigid so that an inserted tray can be firmly held. In addition, the card locking element is moved linearly to engage with the notch on a tray so that the tray is not loosely held. In another embodiment, the above card locking element can also be employed in a card connector that directly receives a different electrical card. The card locking element latches the electrical card and the card ejecting mechanism for facilitating the movement of the card locking element between a locking position and an unlocking position.

The above-described embodiments of the present invention are intended to be illustrative only. Numerous alternative embodiments may be devised by persons skilled in the art without departing from the scope of the following claims.

What is claimed is:

1. A card connector, comprising:

a main body having a receiving space;

a plurality of terminals attached to the main body;

a card locking element including a locking portion configured to be located in the receiving space when the card locking element is in a locking position, an operating portion, and a first interacting portion; and

a card ejecting mechanism comprising:

an actuator movable between an outward position and an inward position, having a second interacting portion configured to engage with the first interacting portion for linked movement of the card locking element and the actuator; and

a levering member pivoted adjacent the rear of the receiving space, including a first arm part and a second arm part, the second arm part having a second end section extending adjacent to the operating portion of the card locking element, the first arm part having a first end portion that can be swung into the receiving space when the second end section is pushed by the operating portion of the card locking element;

wherein the first and second interacting portions allow the linear movement of the card locking element between the locking position and an unlocking position simultaneous with the movement of the actuator between the outward position and the inward position.

2. The card connector of Claim 1, further comprising an elastic member providing an elastic force counteracting a force moving the actuator inward, and moving the actuator outward when the force is removed.

3. The card connector of Claim 2, wherein the second interacting

portion comprises a slot inclined at an angle of 45 degrees relative to the moving direction of the actuator, and the first interacting portion comprises a pin movable in the slot.

4. The card connector of Claim 3, wherein the card locking element further comprises a plate portion movable within a space defined by a bottom surface of the main body and the actuator.

5. The card connector of Claim 4, wherein the operating portion of the card locking element comprises a groove and the main body comprises a projection passing through the groove.

6. The card connector of Claim 5, wherein the main body comprises a concave space, and the actuator moves in the concave space.

7. The card connector of Claim 6, wherein the main body comprises a channel formed in the concave space, and the elastic member is in the channel.

8. The card connector of Claim 7, wherein the operating portion of the card locking element includes a side opposite the receiving space, and the second end section of the levering member includes a tab portion disposed adjacent to the side.

9. The card connector of Claim 8, wherein the main body includes a recessed area, and the actuator includes a bent end restrictedly moved in the recessed area.

10. The card connector of Claim 9, wherein the main body includes an opening formed on a front side wall of the main body to expose the bent end of the actuator, wherein the actuator is moved inward by pushing the bent end of the actuator through the opening.

11. The card connector of Claims 1 to 10, wherein the card

locking element and the actuator respectively move in two perpendicular directions.

12. The card connector of Claim 11, wherein the card locking element is rigid.

13. A card connector, comprising:

a tray having a notch;

a main body having a receiving space for receiving the tray;

a plurality of terminals attached to the main body;

a card locking element including a locking portion configured to be in the notch when the card locking element is in a locking position, an operating portion, and a first interacting portion; and

a card ejecting mechanism comprising:

an actuator movable between an outward position and an inward position, having a second interacting portion configured to engage with the first interacting portion for linked movement of the card locking element and the actuator; and

a levering member pivoted adjacent to the rear of the receiving space, including a first arm part and a second arm part, the second arm part having an second end section extending adjacent to the operating portion of the card locking element, the first arm part having a first end portion that can be swung into the receiving space when the second end section is pushed by the operating portion of the card locking element;

wherein the first and second interacting portions allow the linear movement of the card locking element between the locking position and an unlocking position simultaneous with the movement of the actuator between the outward position and the inward position.

14. The card connector of Claim 13, further comprising an elastic

member providing an elastic force counteracting a force moving the actuator inward, and moving the actuator outward when the force is removed.

15. The card connector of Claim 14, wherein the second interacting portion comprises a slot inclined at an angle of 45 degrees relative to the moving direction of the actuator, and the first interacting portion comprises a pin movable in the slot.

16. The card connector of Claim 15, further comprising a detective contact disposed on the main body and a detective member having an end portion and a touch portion protruding into the receiving space for engaging with an inserted electrical card, wherein the detective member is elastically deformable to allow the end portion to move toward and away from the detective contact.

17. The card connector of Claim 16, wherein the tray comprises a side wall surrounding a card-holding space for receiving an electrical card and a breach formed on the side wall, wherein the breach is configured to prevent the touch portion of the detective member from interfering with an inserted empty tray.

18. The card connector of Claim 17, wherein the card locking element further comprises a plate portion movable within a space defined by a bottom surface of the main body and the actuator.

19. The card connector of Claim 18, wherein the operating portion of the card locking element comprises a groove and the main body comprises a projection passing through the groove.

20. The card connector of Claim 19, wherein the main body comprises a concave space, wherein the actuator moves in the concave space.

21. The card connector of Claim 20, wherein the main body comprises a channel formed in the concave space, and the elastic member is in the channel.

22. The card connector of Claim 21, wherein the operating portion of the card locking element includes a side opposite the receiving space, and the second end section of the levering member includes a tab portion disposed adjacent to the side.

23. The card connector of Claim 22, wherein the main body includes a recessed area, and the actuator includes a bent end restrictedly moved in the recessed area.

24. The card connector of Claim 23, wherein the main body includes an opening formed on a front side wall of the main body to expose the bent end of the actuator and the tray includes a bar member and a hole formed on the bar member and corresponding to the opening, wherein the actuator is moved inward by pushing the bent end of the actuator through the opening and the hole.

25. The card connector of Claims 13 to 24, wherein the card locking element and the actuator respectively move in two perpendicular directions.

26. The card connector of Claim 25, wherein the card locking element is rigid.

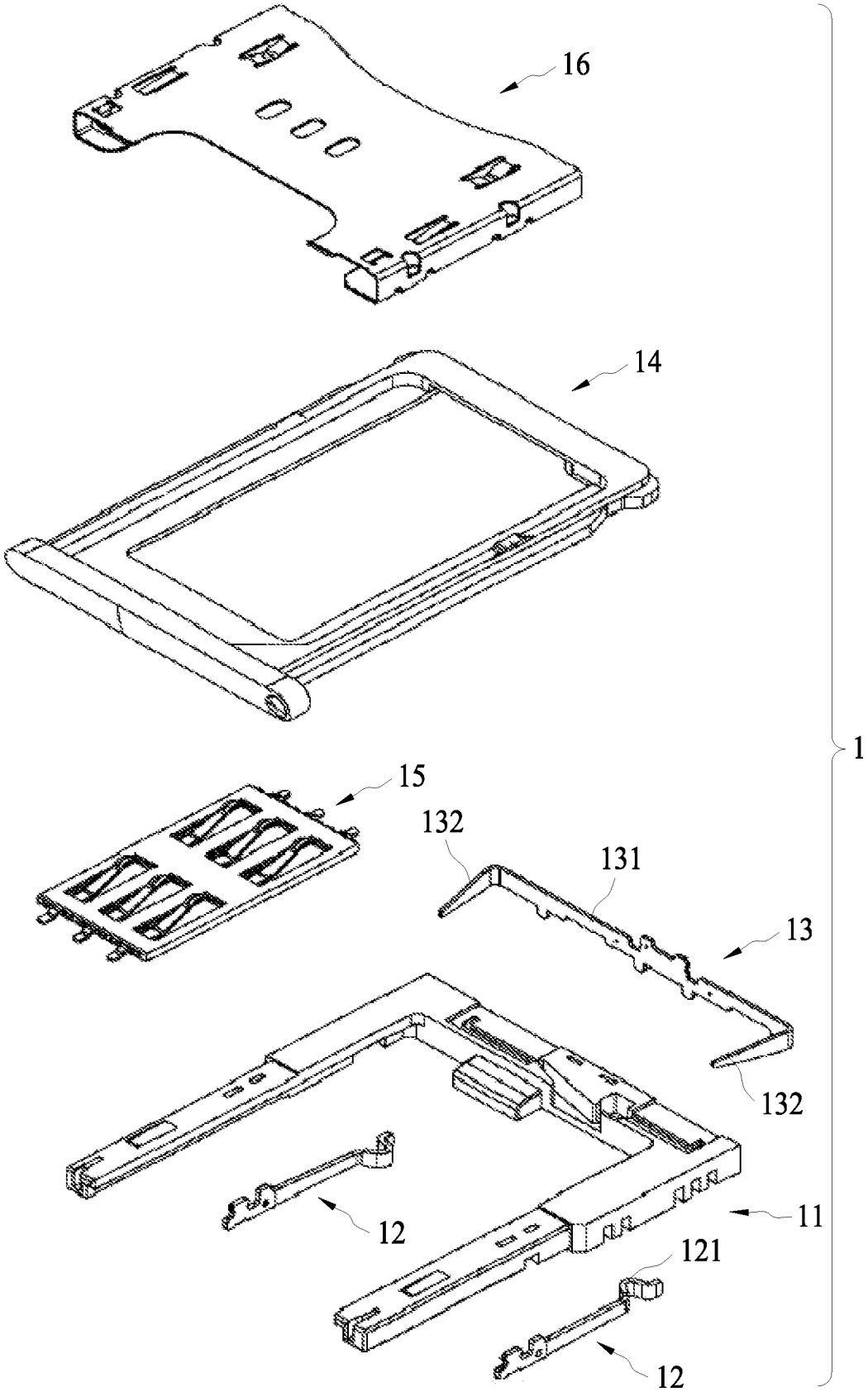

FIG. 1

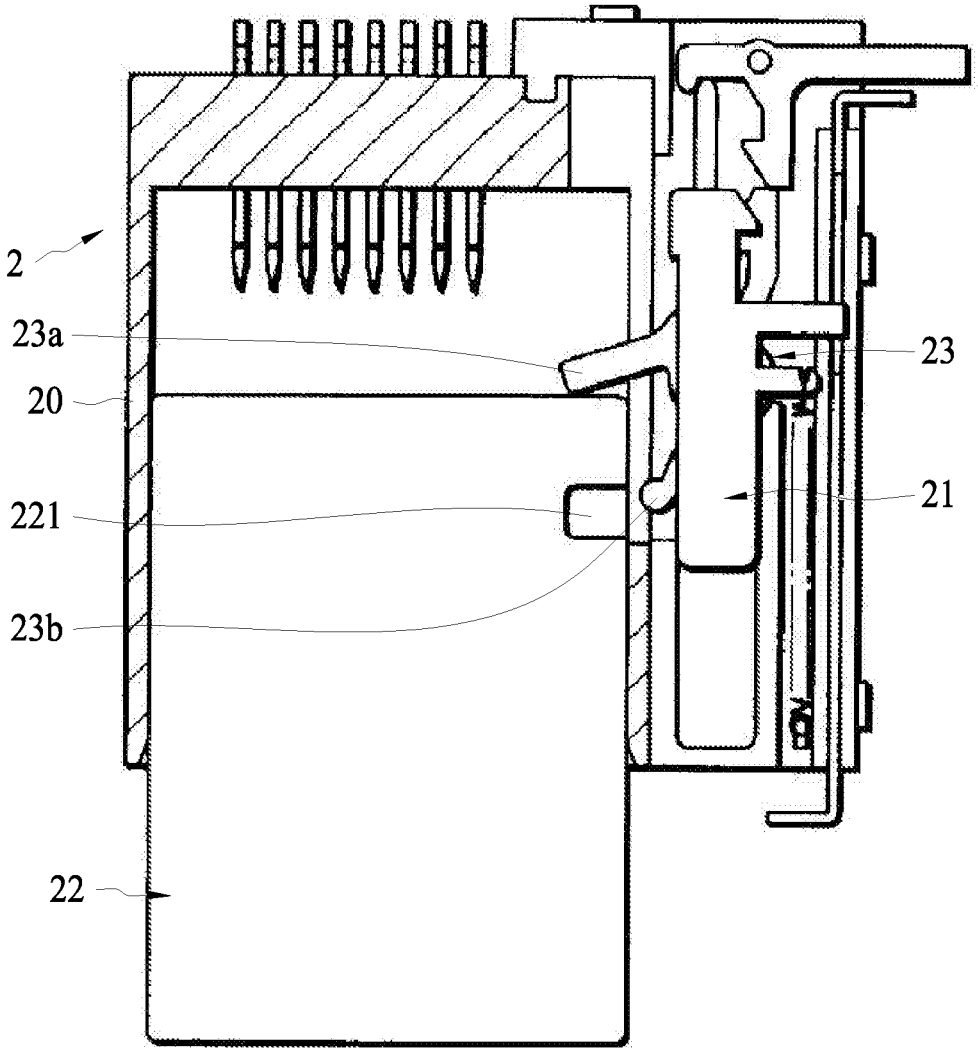

FIG. 2A

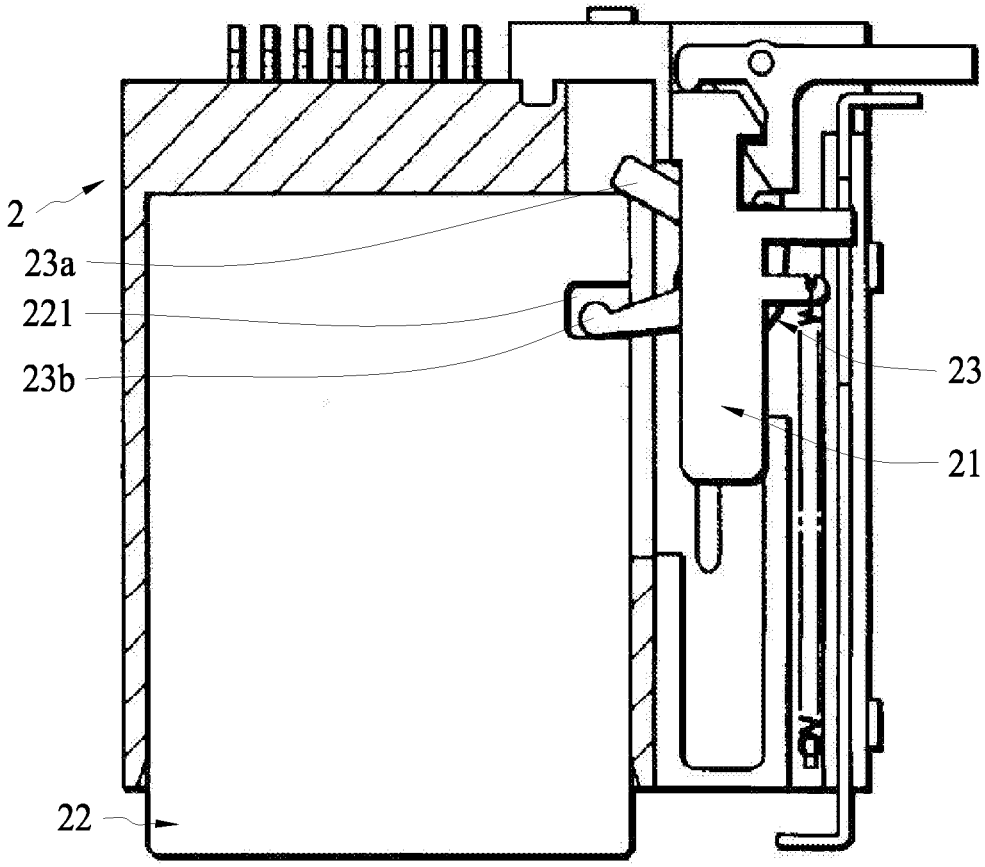

FIG. 2B

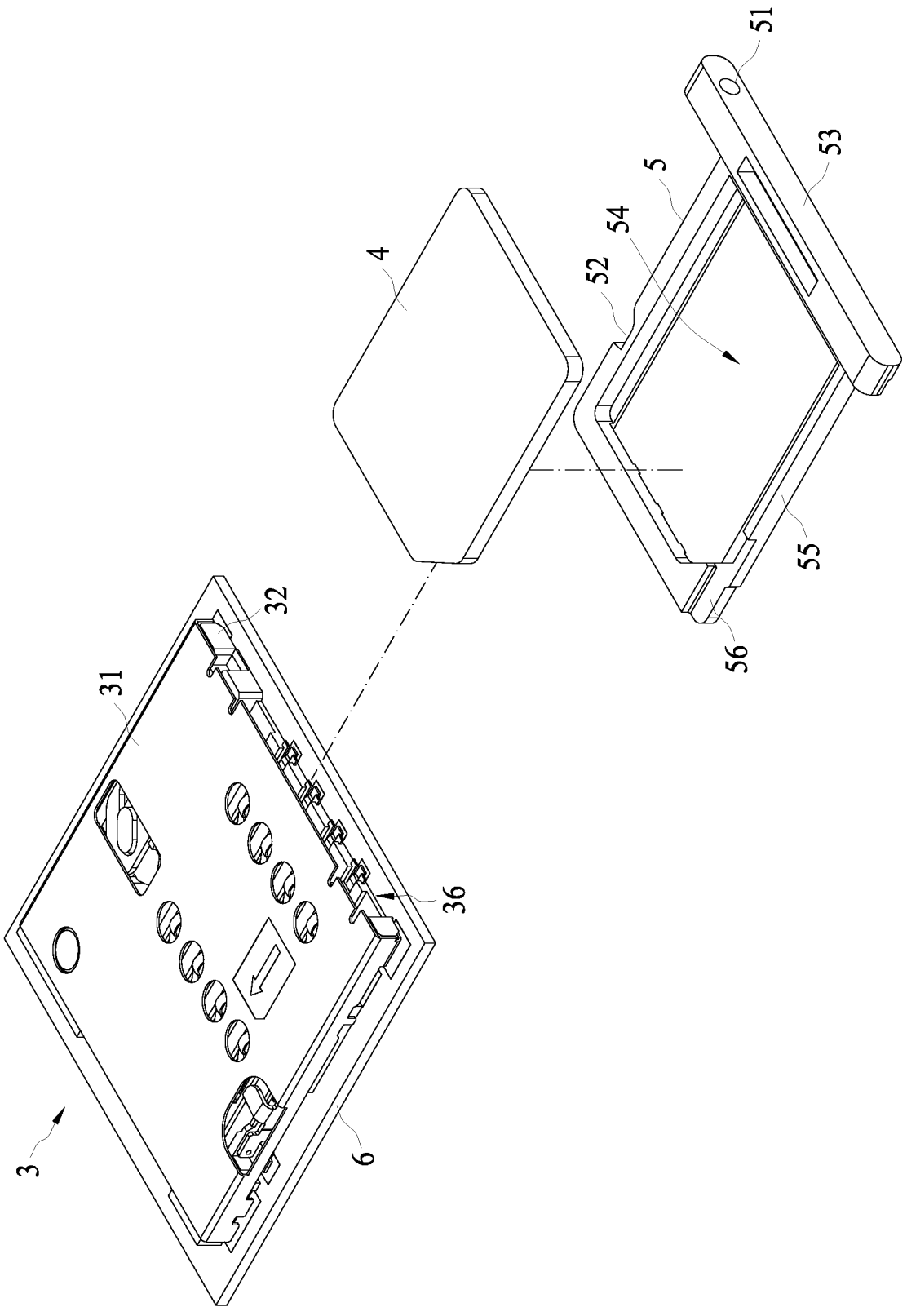

FIG. 3

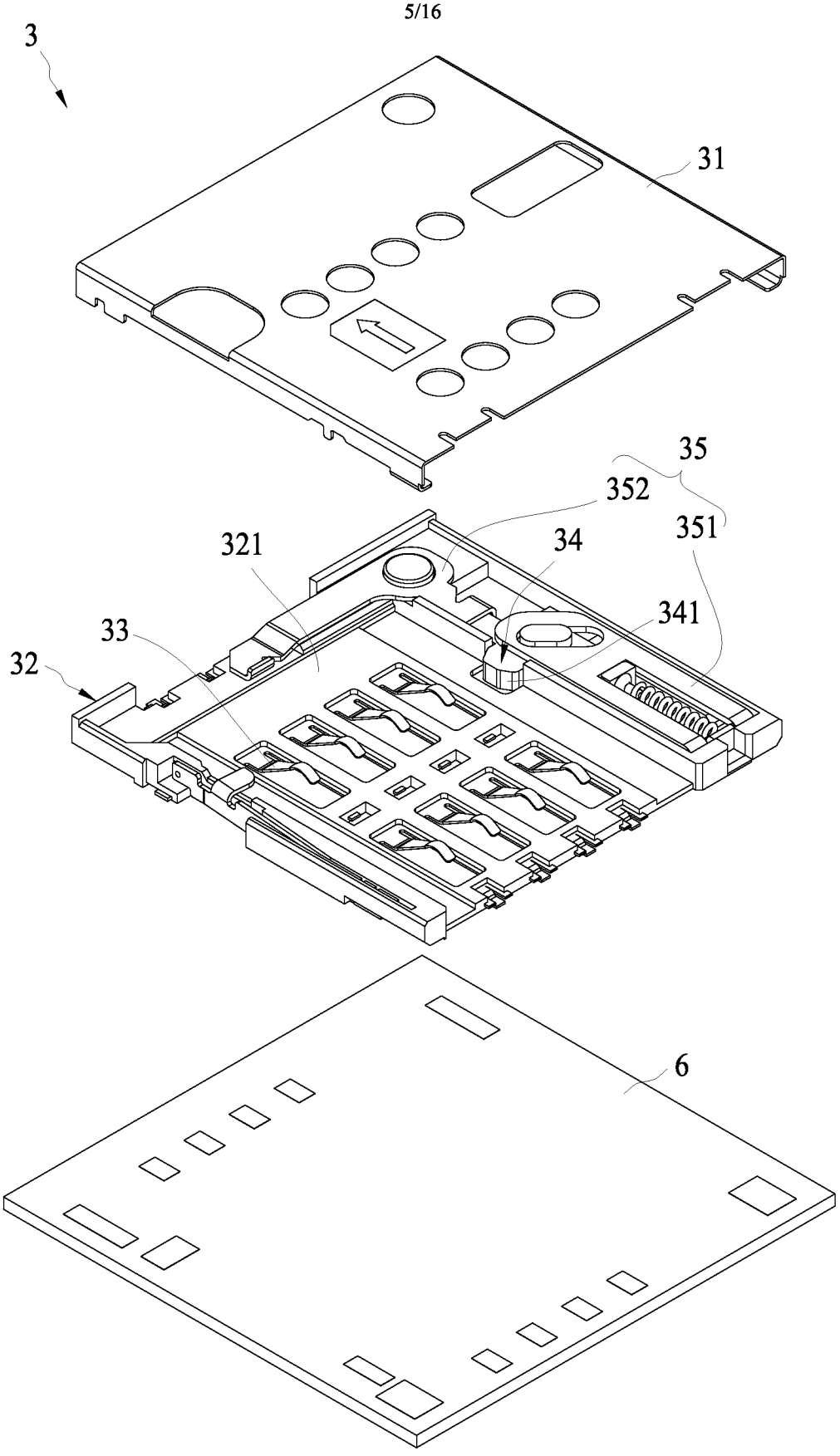

FIG. 4

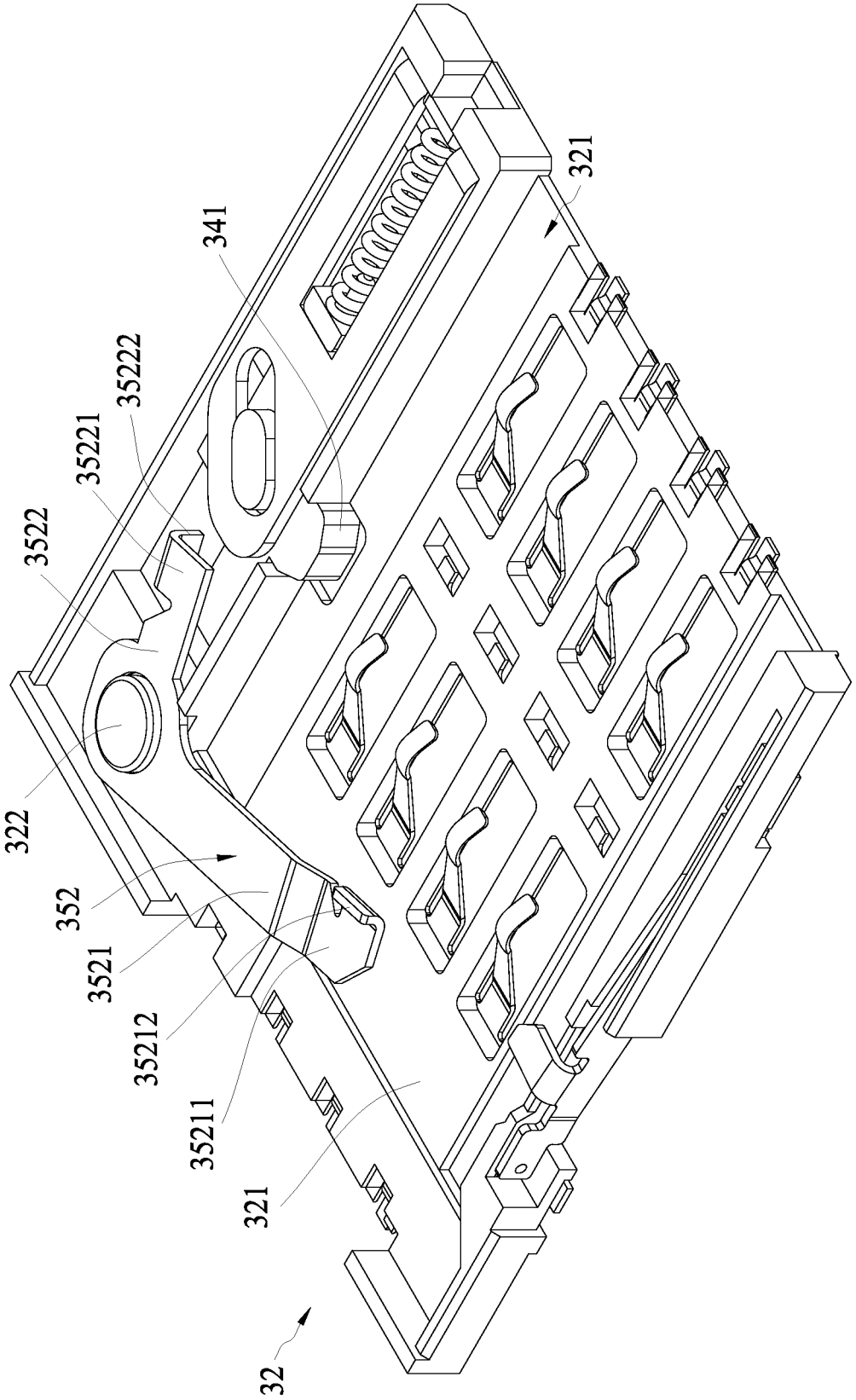

FIG. 5

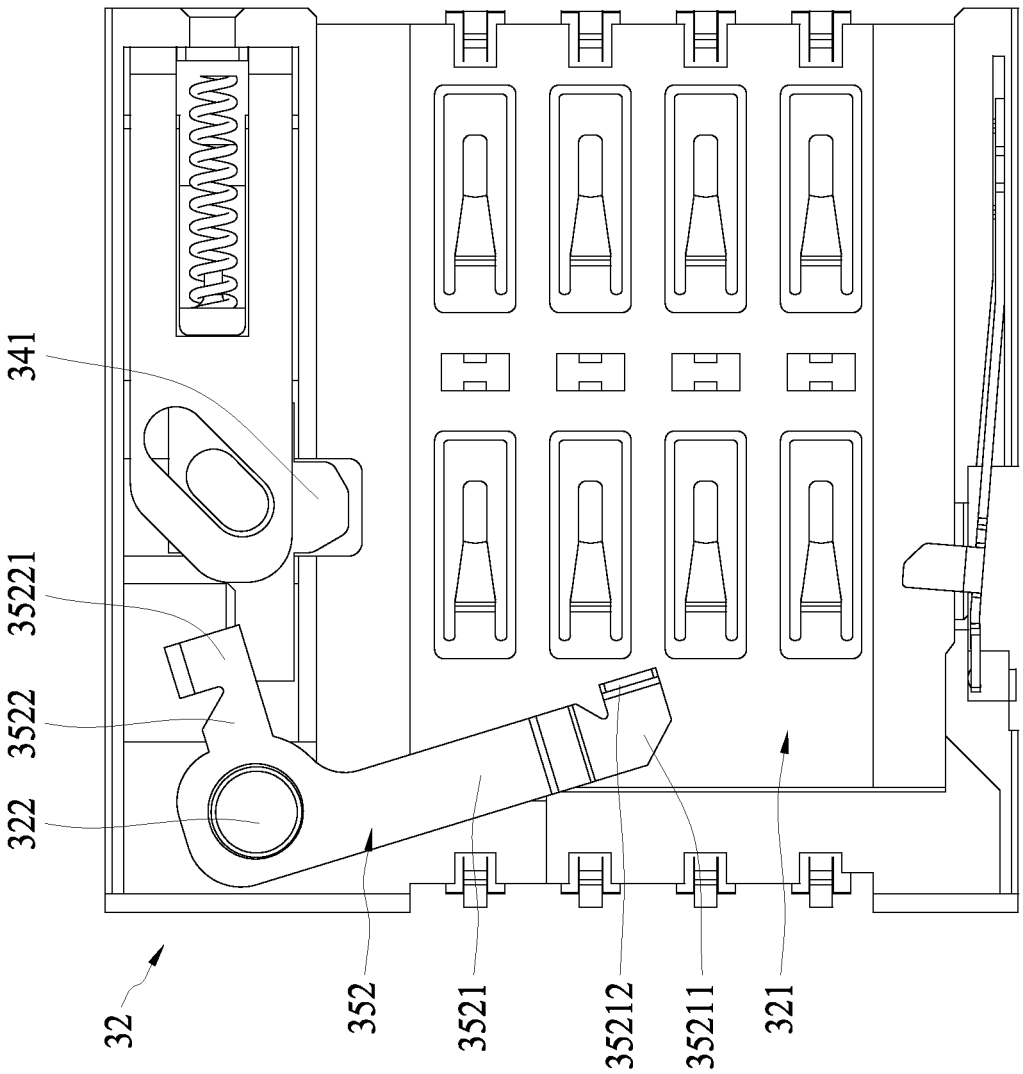

FIG. 6

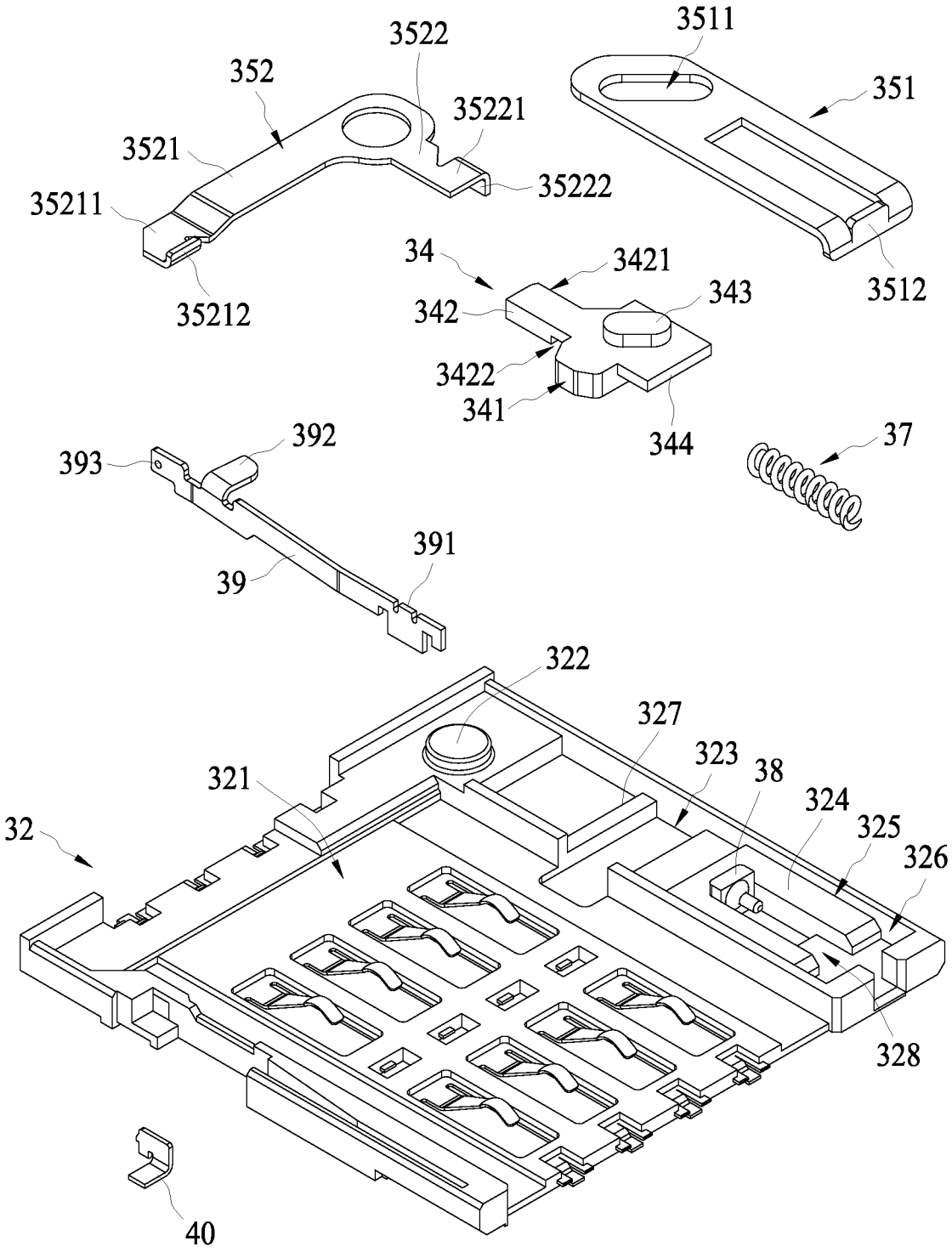
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FIG. 7

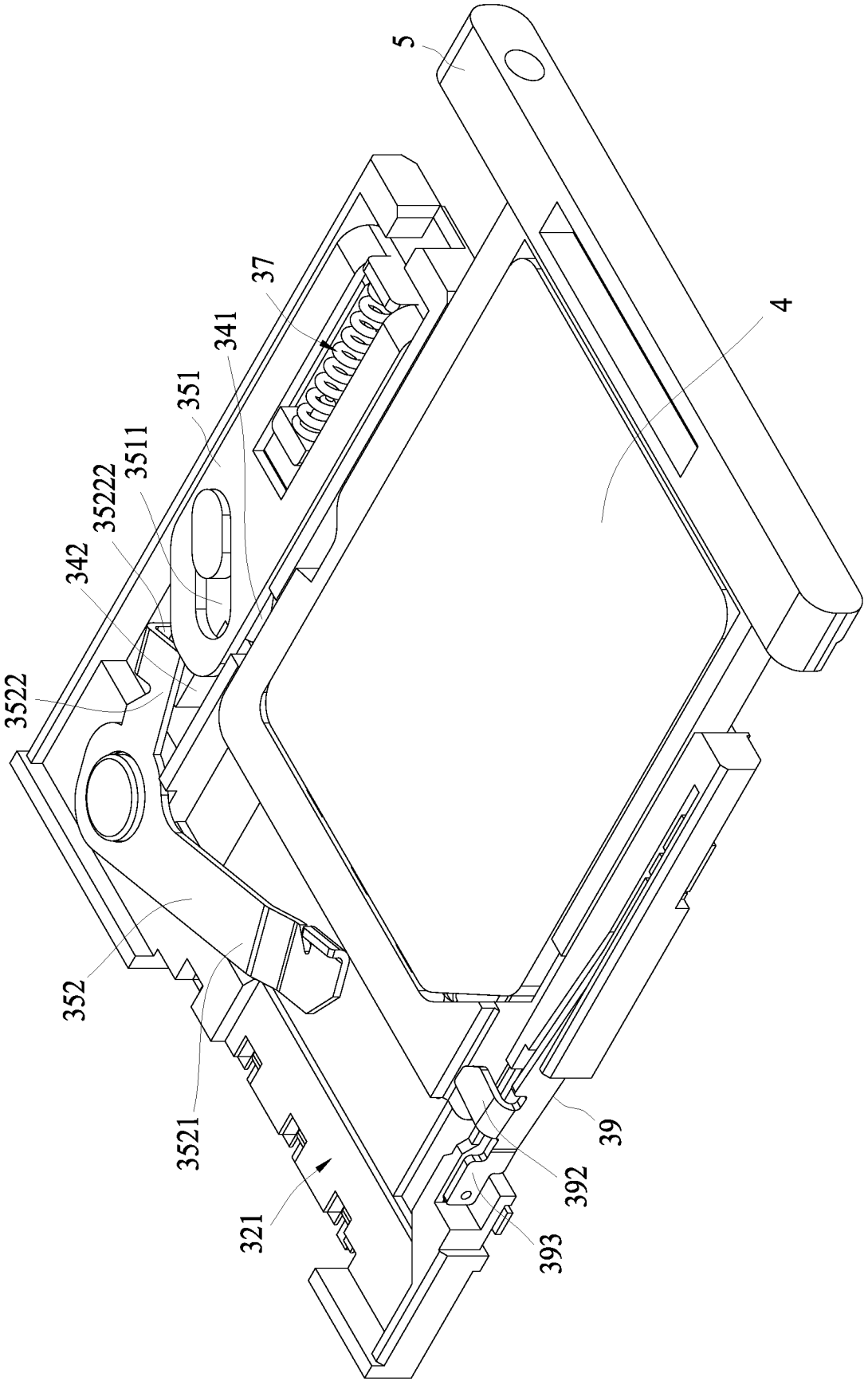

FIG. 8

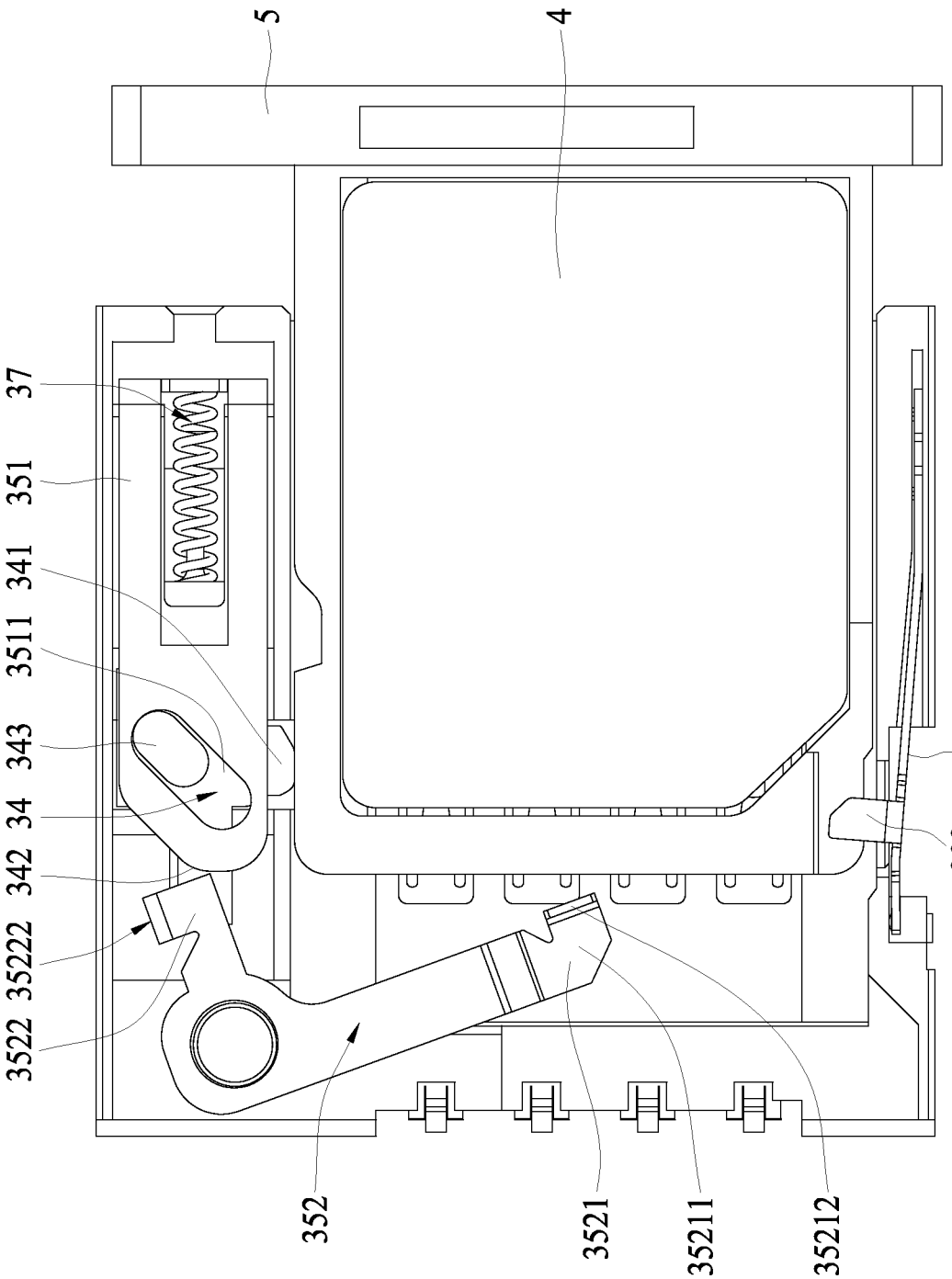
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FIG. 9

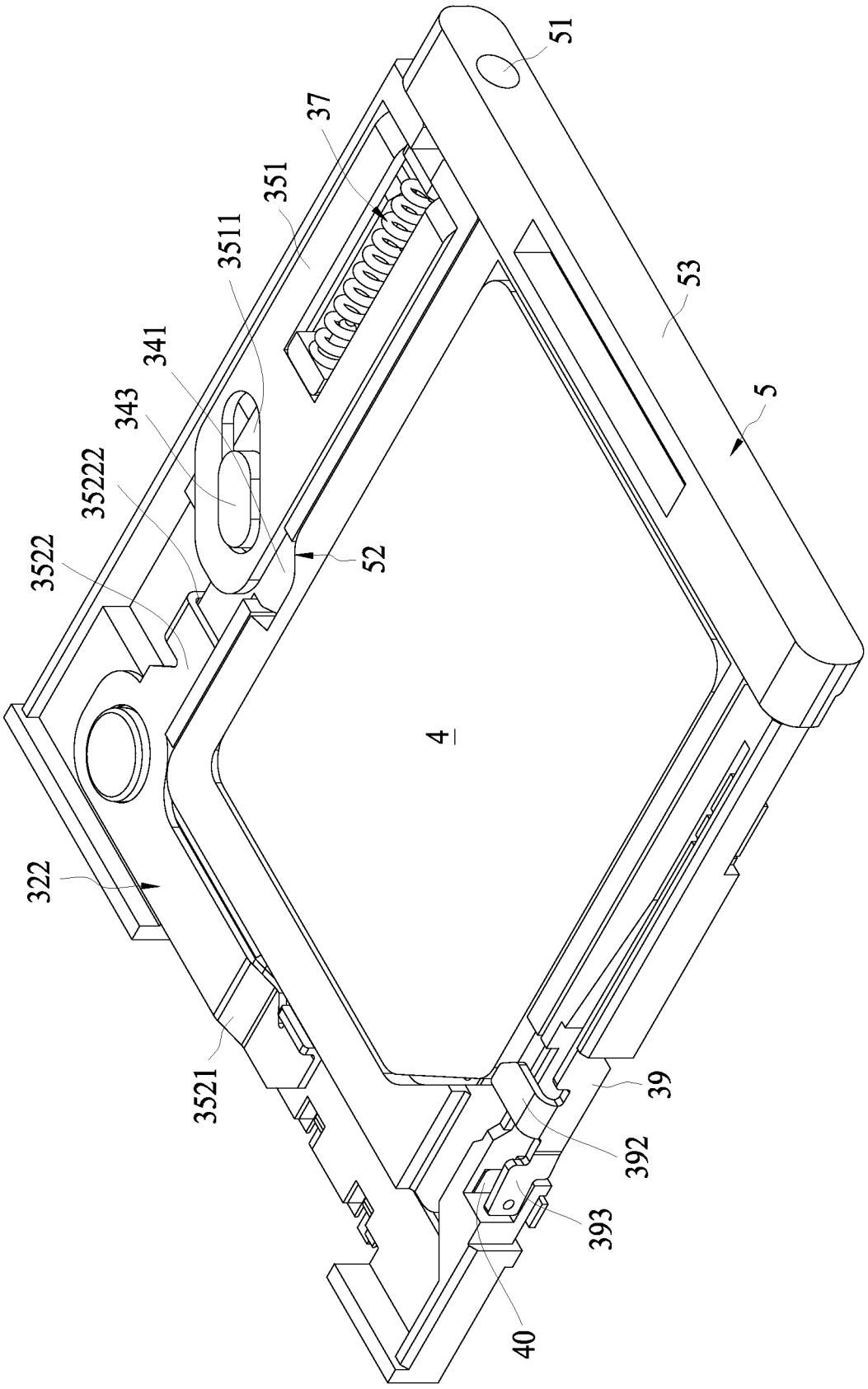

FIG. 10

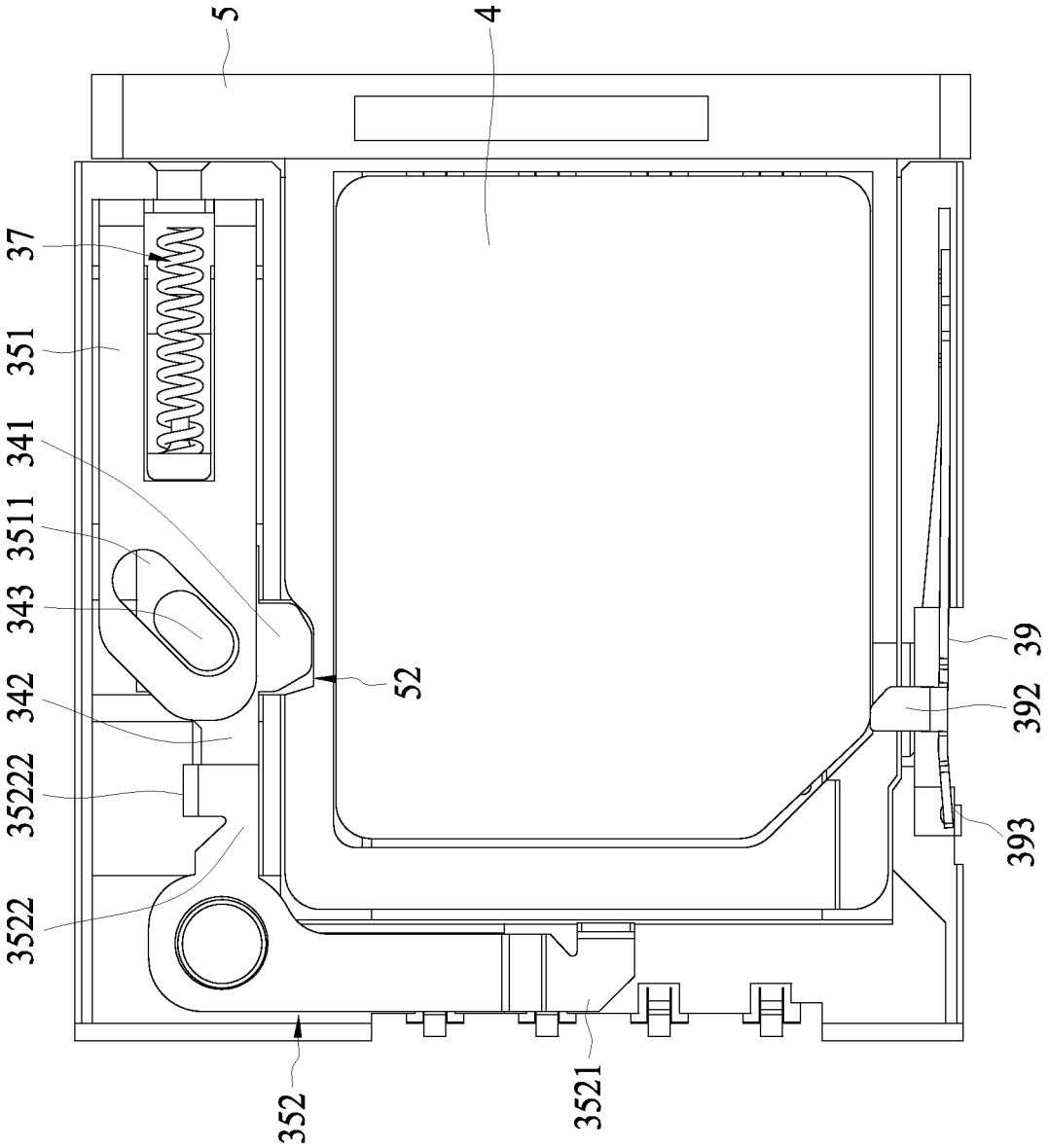

FIG. 11

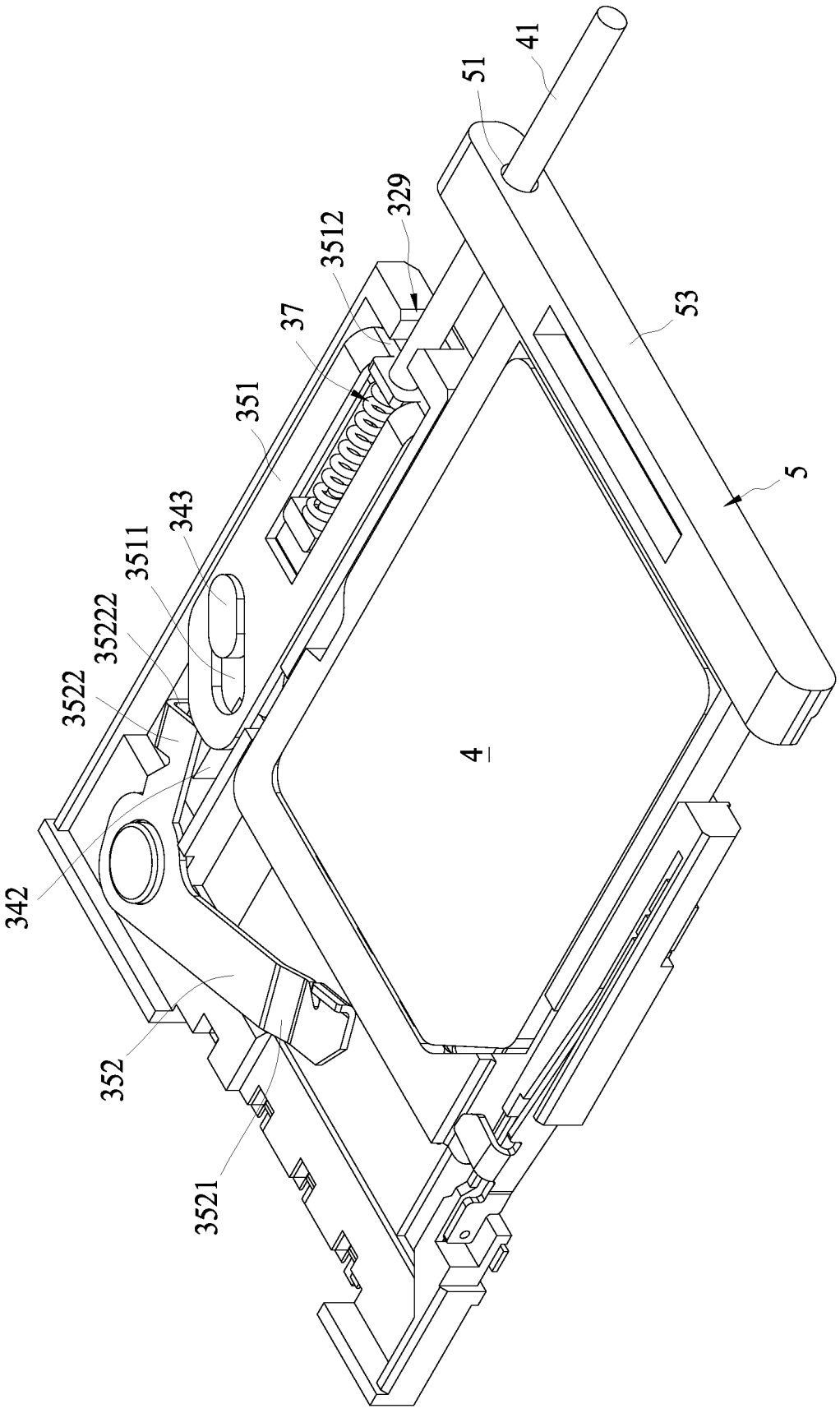

FIG. 12

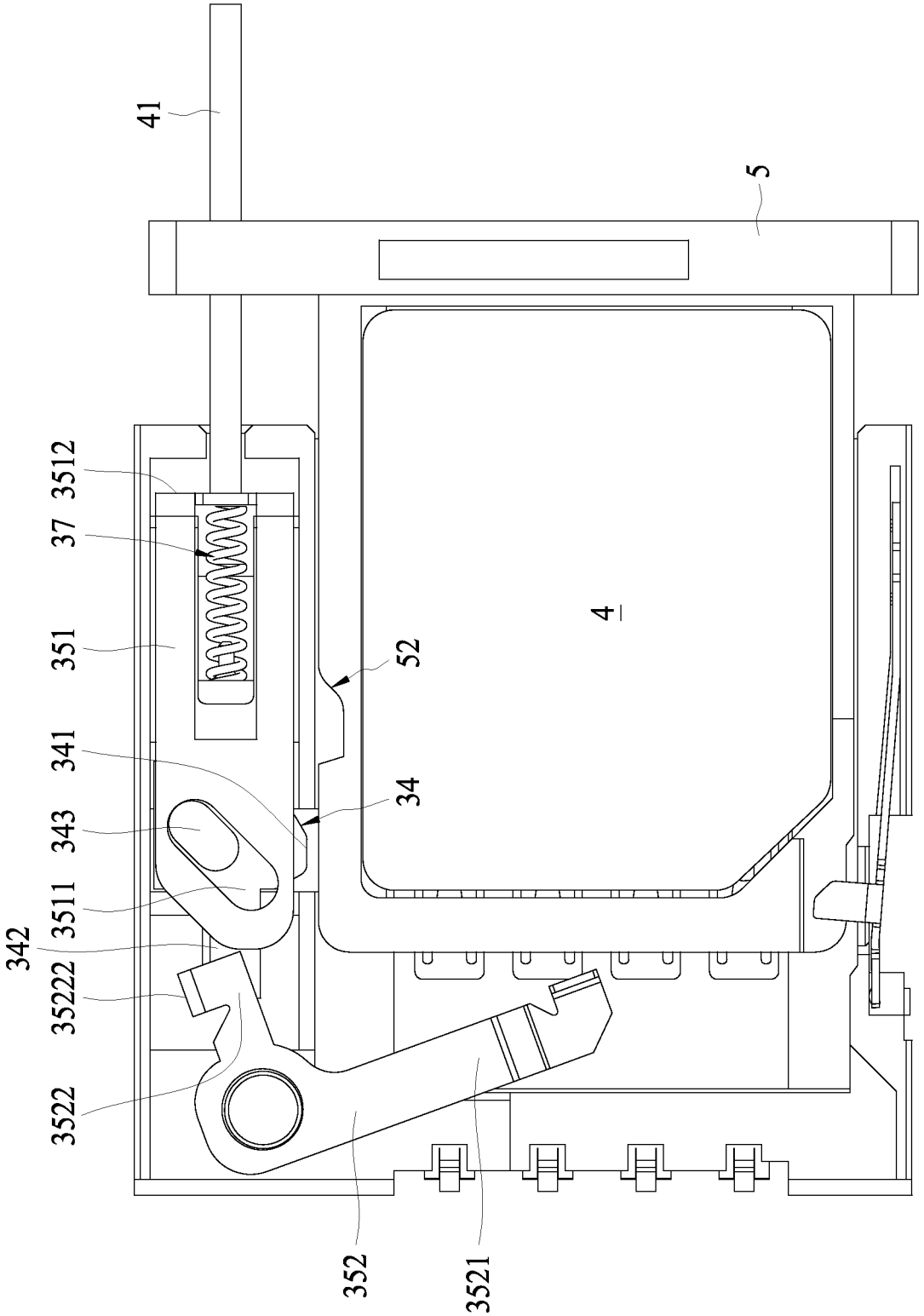

FIG. 13

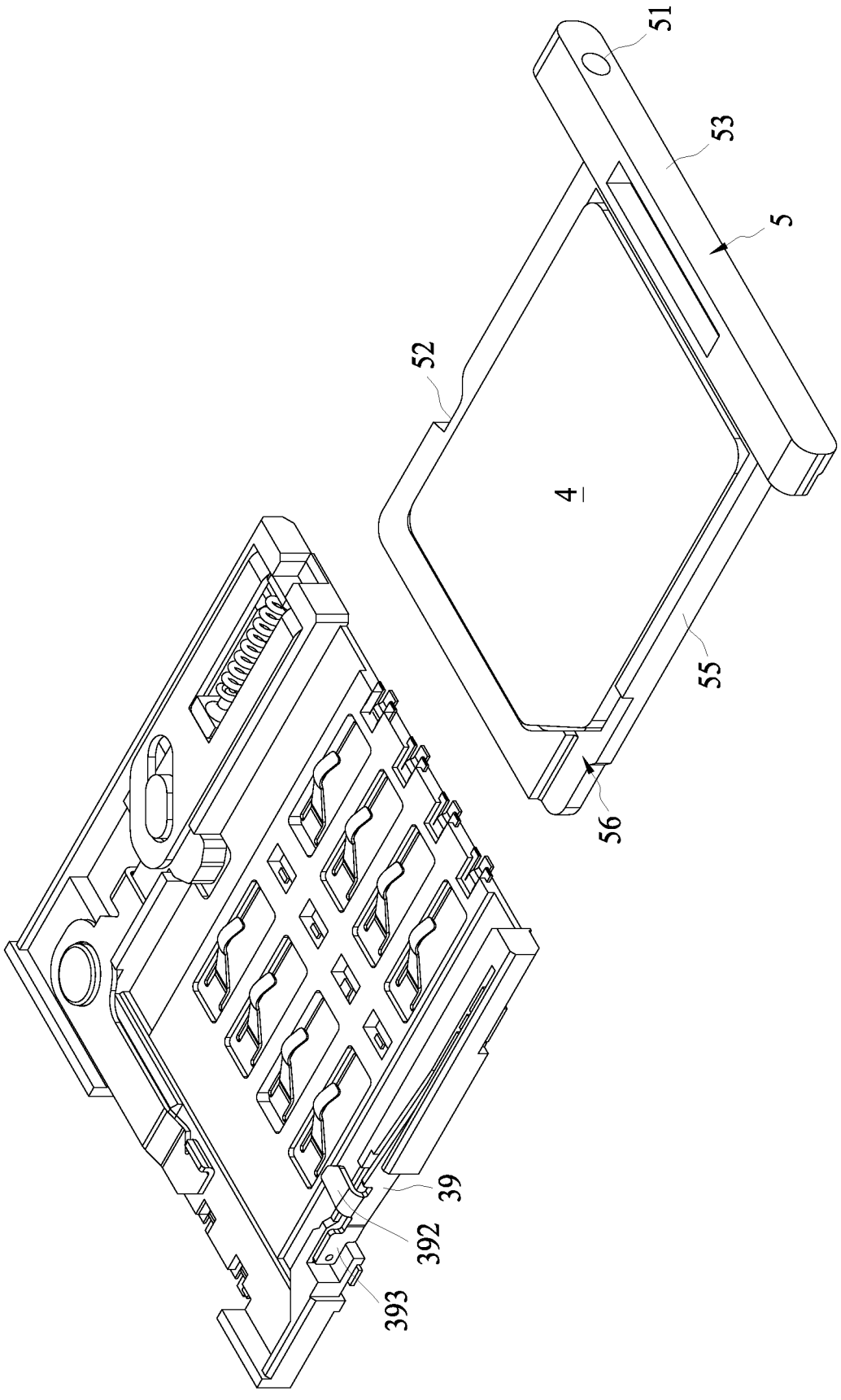

FIG. 14

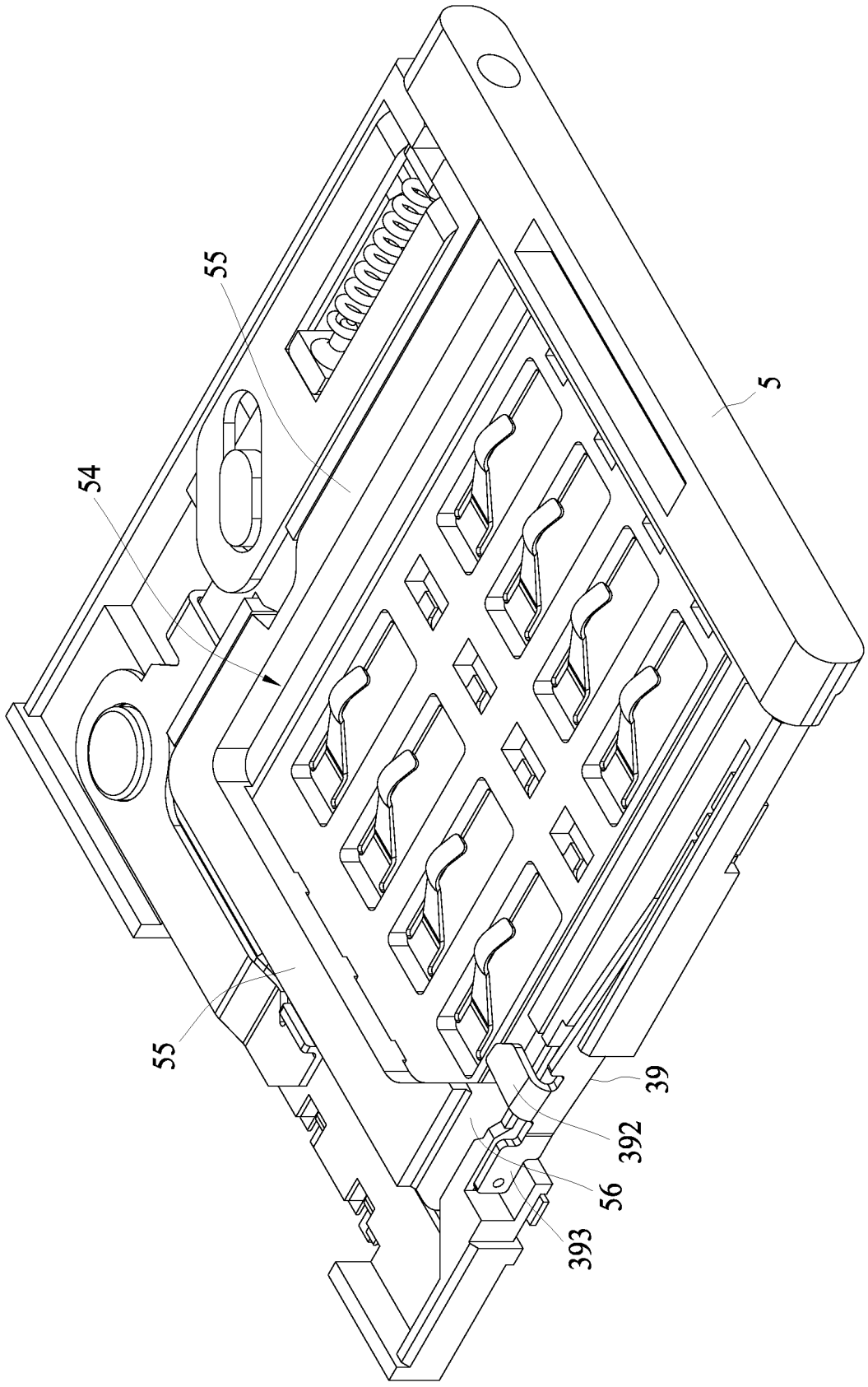

FIG. 15