



(22) Date de dépôt/Filing Date: 2012/12/12

(41) Mise à la disp. pub./Open to Public Insp.: 2013/08/20

(45) Date de délivrance/Issue Date: 2014/12/02

(30) Priorité/Priority: 2012/02/20 (JP2012-034056)

(51) Cl.Int./Int.Cl. *B60K 1/02* (2006.01),
B60L 11/18 (2006.01), *B60S 5/06* (2006.01)

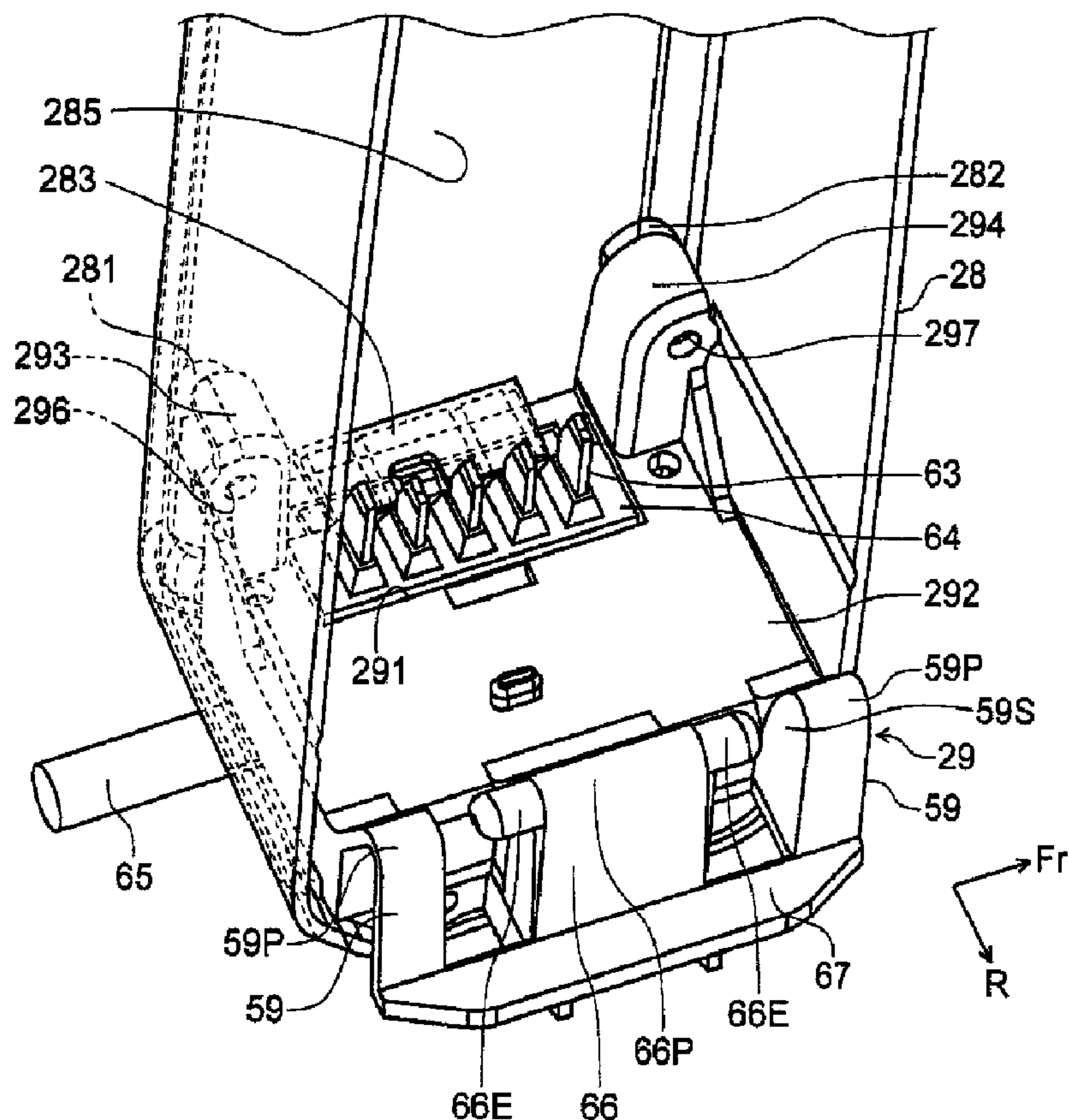
(72) Inventeurs/Inventors:
KAWATANI, SHINJI, JP;
NAKAYAMA, MASARU, JP;
SHOKAKU, ISAO, JP

(73) Propriétaire/Owner:
HONDA MOTOR CO., LTD., JP

(74) Agent: DENNISON ASSOCIATES

(54) Titre : DISPOSITIF D'ALIMENTATION EN ELECTRICITE POUR UN VEHICULE ELECTRIQUE

(54) Title: POWER SUPPLY DEVICE FOR ELECTRIC VEHICLE



(57) Abrégé/Abstract:

A battery pack includes a battery case for accommodating battery cells for mounting to and detaching from an electric vehicle. The battery case includes a terminal that is downwardly connectible with an upwardly facing vehicle body terminal. Mounting of the



(57) **Abrégé(suite)/Abstract(continued):**

battery case in the electric vehicle also provides connection of the battery pack to the electric vehicle. The base of the battery case and a mounting part on the vehicle body cooperate to assist in mounting and securement of the battery case to the vehicle while allowing convenient release thereof.

WH-13925CA
SN 2,798,658

Abstract:

A battery pack includes a battery case for accommodating battery cells for mounting to and detaching from an electric vehicle. The battery case includes a terminal that is downwardly connectible with an upwardly facing vehicle body terminal. Mounting of the battery case in the electric vehicle also provides connection of the battery pack to the electric vehicle. The base of the battery case and a mounting part on the vehicle body cooperate to assist in mounting and securement of the battery case to the vehicle while allowing convenient release thereof.

POWER SUPPLY DEVICE FOR ELECTRIC VEHICLE

FIELD OF THE INVENTION

5

The present invention relates to a power supply device for electric vehicle. More particularly, the invention relates to a power supply device for electric vehicle which is suitable for providing a simple structure for detachably supporting a battery pack, with battery cells accommodated therein, to a vehicle body.

10

BACKGROUND OF THE INVENTION

Conventionally, in an electric vehicle, a battery pack having a plurality of battery cells assembled in a battery case has commonly been mounted as a power supply device at a center portion of a frame of the electric vehicle. For instance, in a battery lock structure for electric bicycle described in Japanese Patent Laid-open No. 2000-142551, a support shaft and an engagement projection are provided on the battery side. On the other hand, a tentative positioning part and a locking surface part with which to engage the support shaft and the engagement projection on the battery side, and brackets each formed with a guide surface part for guiding the support shaft and a relief part, are provided on the electric bicycle side. At the time of mounting the battery to the vehicle body from a lateral side of the vehicle body, the battery is moved to the tentatively positioning part, while setting the support shaft along the guide surface parts of the brackets. Furthermore, the battery is turned toward the vehicle-width-directionally inner side, with the support shaft supported on the tentative positioning part as a center of turning, and the engagement projection is locked to the locking surface part as a wedge. According to this electric bicycle, the tentative positioning and the locking of the battery are carried out using different component parts, namely, the support shaft and the

- 2 -

engagement projection. Consequently, the battery after mounted can be prevented from chattering.

In the electric bicycle, electrical connection parts are necessary for supply of electric power from the battery mounted onto the vehicle body to a motor, etc. provided as electrical equipments on the vehicle body side (the electrical connection parts are not clearly shown in Japanese Patent Laid-open No. 2000-142551). On the vehicle body side, therefore, the above-mentioned brackets are provided in addition to members for holing the electrical connection parts onto the vehicle body. Thus, the number of component parts is increased. In addition, the support shaft and the engagement projection, etc. are provided at an outer circumferential surface of the battery. This results in that at the time of carrying or storing the battery, extra care should be taken in handling the battery so as not to damage the support shaft or the engagement projection or the like by mistake.

SUMMARY OF THE INVENTION

Accordingly, one aspect of the present invention to provides a power supply device for electric vehicle in which a battery pack is free of protruding parts and by which the battery pack can be tentatively positioned with a simple structure, thereby solving the above-mentioned problems.

According to one aspect of the present invention, there is provided a power supply device for electric vehicle, which includes a battery case for accommodating battery cells for supplying electric power to a traveling electric motor of an electric vehicle and which can be mounted to and detached from the electric vehicle, characterized firstly in that the power supply device further includes a battery case side terminal to be connected from above to a vehicle body side terminal accommodated in a terminal base provided on a vehicle body, and a battery case side engagement part for engagement from above with a vehicle body side engagement part formed at an upper surface of the terminal base; the vehicle body side engagement part is disposed at a position deviated to one side from a vehicle-width-directional center; and the battery case side engagement part is disposed at a position deviated to vehicle-width-directionally one side of the battery case in a state where the battery case is mounted on the electric vehicle, and the battery case side engagement part is formed at each of vehicle-longitudinal-directionally both end

- 3 -

portions of the battery case, in order that the battery case side engagement part can fit to the vehicle body side engagement part.

In another aspect of the invention, the power supply device is characterized in that the vehicle body side engagement part is an engagement projection, the battery case side engagement part is an engagement recess which fits to the engagement projection, and, for mutual positioning, the engagement projection and the engagement recess are provided with wall parts parallel to a direction in which the battery case is mounted to and detached from the electric vehicle.

According to the above aspects of the invention, the battery case side engagement parts are formed on vehicle-width-directionally one side and at vehicle-longitudinal-directionally both end portions in the state in which the battery case is mounted on the electric vehicle, in order that the battery case side engagement parts can fit to the vehicle body side engagement parts. Therefore, at the time of mounting or detaching the power supply device to or from the vehicle while operating on vehicle-width-directionally one side of the vehicle, the operation can be carried out while visually checking the positions of the battery case side engagement parts and the vehicle body side engagement parts from the vehicle-width-directionally one side of the vehicle. Especially, according to the second characteristic, at the time of starting mounting of the battery case to the terminal base, the positioning of the battery pack in the vehicle-longitudinal direction relative to the terminal base can be performed by setting the wall parts of the battery case side engagement parts along the wall parts of the vehicle body side engagement parts. Therefore, the battery case side engagement parts can easily be engaged with the vehicle body side engagement parts.

In another aspect of the invention, the power supply device is characterized in that the terminal base is formed with a shelf protruding horizontally from a foot portion of the engagement projection constituting the vehicle body side engagement part toward the side to which the vehicle body engagement part is deviated; and the positions and shapes of the engagement projection as the vehicle body side engagement part, the engagement recess as the battery case side engagement part, and the shelf are so set that a lower open end portion of the engagement recess makes contact with an upper surface of the shelf in a tentatively placed posture wherein a peak portion of the engagement projection makes contact with an inner surface of an uppermost portion of a wall part forming the engagement recess.

According to the above aspect of the invention, it is ensured that at the time of mounting or detaching the power supply device to or from the vehicle, tentative placing of the power supply device can be achieved in such a manner that the lower
5 open end portion of the engagement recess as the battery case side engagement part makes contact with the upper surface of the shelf protruding horizontally from the terminal base. Therefore, the power supply device can easily be mounted and detached.

10 In yet another aspect of the invention, the power supply device is characterized in that the battery case is roughly rectangular parallelopiped in general shape, a lower surface of the roughly rectangular parallelopiped being formed with a slant surface extending obliquely upward from the lower open end portion of the engagement recess toward that one of surfaces adjacent to the lower surface which is
15 adjacent on the side of protrusion of the shelf; and the inclination angle of the slant surface is so set that the slant surface is situated along the upper surface of the shelf in the tentatively placed posture.

According to the above aspect of the invention, the power supply device can be
20 tentatively placed in a stable posture, by seating the slant surface of the battery case on the shelf.

In a further aspect of the invention, the power supply device is characterized in that the vehicle body side engagement part is provided at each of two positions of an
25 upper surface of the terminal base; the terminal base is provided with a vehicle body side second engagement part disposed between the vehicle body side engagement parts at the two positions, and with horizontal engagement parts protruding horizontally from a peak portion of the engagement projection as the vehicle body side second engagement part toward the vehicle body side engagement portions at
30 the two positions.

According to the above aspect of the invention, it is ensured that in the completely mounted posture of the power supply device relative to the vehicle, the lower surface of the horizontal engagement part protruding horizontally from the
35 terminal base side is engaged with the upper surface of the shelf part formed on the battery case. Therefore, the battery case is restrained from moving upward relative to the terminal base.

In yet another aspect of the invention, the power supply device is characterized in that the engagement recess as the battery case side engagement part includes a wall part coinciding roughly with a locus of movement of the peak portion of the engagement projection, in the course of inclining the battery case from the tentatively placed posture to a completely mounted posture.

According to the above aspect of the invention, it is ensured that during when the battery case is inclined from the tentatively placed posture to the completely mounted posture, the change in posture can be achieved by putting the peak portion of the engagement projection along the wall part of the battery case side engagement part.

In yet another aspect of the invention, the power supply device is characterized in that a lower surface of the battery case is formed with a fitting hole in which a projected part provided on an upper surface of the terminal base is fitted in a completely mounted posture.

According to the above aspect of the invention, the projected part is fitted in the fitting hole in the completely mounted state of the power supply device. Therefore, the position of the battery case is restrained on the terminal base.

In a further aspect of the invention, the power supply device is characterized in that, of the terminal base and a battery cover attached to the terminal base, the battery cover covering a half on a vehicle-width-directional one side opposite to a vehicle-width-directional one side on which the vehicle body side engagement part and the battery case side engagement part are provided is fixed to the vehicle body, and the terminal base is attached to the battery cover.

According to the above aspect of the invention, the terminal base and the battery case are covered in half by the battery pack cover in the condition where the power supply device is mounted on the vehicle. Therefore, electrical connection terminals provided on the terminal base can be covered and protected by the battery pack cover. In addition, during the operation of mounting the power supply device to the vehicle, visual checking of the positional relationship between the battery case side engagement parts and the vehicle body side engagement part would not be obstructed by the battery pack cover.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are shown in the drawings, wherein:

5

FIG. 1 is a right side view of an essential part of an electric vehicle provided with an electric vehicle control system according to an embodiment of the present invention.

10

FIG. 2 is a left side view of an essential part of the electric vehicle provided with the electric vehicle control system according to the embodiment of the present invention.

15

FIG. 3 is a perspective view of an essential part of the electric vehicle, as viewed from a right front side.

FIG. 4 is a perspective view of a lock device, as viewed from a right upper side of the vehicle body.

20

FIG. 5 is a sectional view showing a section passing through a lock pin of the lock device, as viewed from the right side of the vehicle body.

25

FIG. 6 is a perspective view of a battery pack accommodated in a battery pack cover, as viewed from a right upper rear side of the vehicle body.

FIG. 7 is a perspective view of a terminal base fixed to the battery pack cover, as viewed from a right upper rear side of the vehicle body.

30

FIG. 8 is a perspective view of the terminal base with an insulator board fitted therein, as viewed from a right upper rear side of the vehicle body.

FIG. 9 is a perspective view of the terminal base, as viewed from a left lower rear side of the vehicle body.

35

FIG. 10 is a perspective view of the battery pack, as viewed from a left upper rear side of the vehicle body.

- 7 -

FIG. 11 is a perspective view of the battery pack, as viewed from a left lower front side of the vehicle body.

5 FIG. 12 is a plan view of a front part of a battery case, as viewed from a vehicle-width-directional center side.

FIG. 13 is a plan view of a rear part of the battery case, as viewed from the vehicle-width-directional center side.

10 FIG. 14 is a view of the battery case, as viewed from the left side of the vehicle body.

FIG. 15 is an enlarged perspective view of an essential part of the battery case.

15 FIG. 16 is a perspective view of a part of the battery case, as viewed from a left lower front side.

20 FIG. 17 is a perspective view of a part in a condition where a fuse and a female-side terminal and an insulator block are mounted, as viewed from a left lower front side.

25 FIG. 18A is a view showing the positional relationship between the battery pack and the terminal base at the time of mounting the battery pack to the battery pack cover.

FIG. 18B is a view showing the positional relationship between the battery pack and the terminal base at the time of mounting the battery pack to the battery pack cover.

30 FIG. 18C is a view showing the positional relationship between the battery pack and the terminal base at the time of mounting the battery pack to the battery pack cover.

35 FIG. 18D is a view showing the positional relationship between the battery pack and the terminal base at the time of mounting the battery pack to the battery pack cover.

FIG. 19A is a view showing the positional relationship between the battery pack cover as well as the terminal base and the battery pack, as viewed from a right upper rear side of the vehicle body, corresponding to FIG. 18A.

5 FIG. 19B is a view showing the positional relationship between the battery pack cover as well as the terminal base and the battery pack, as viewed from a right upper rear side of the vehicle body, corresponding to FIG. 18B.

10 FIG. 19C is a view showing the positional relationship between the battery pack cover as well as the terminal base and the battery pack, as viewed from a right upper rear side of the vehicle body, corresponding to FIG. 18C.

15 FIG. 19D is a view showing the positional relationship between the battery pack cover as well as the terminal base and the battery pack, as viewed from a right upper rear side of the vehicle body, corresponding to FIG. 18D.

FIG. 20 is a front view (as viewed from the right side of the vehicle body) of a male-side terminal unit.

20 FIG. 21 is a perspective view (as viewed from a rear right lower side of the vehicle body) of the male-side terminal unit.

FIG. 22 is a plan view of the male-side terminal unit.

25 FIG. 23 is a side view (as viewed from the front side of the vehicle body) of the male-side terminal unit.

30 FIG. 24 is a perspective view of an insulator block 74 with female-side terminals accommodated therein, as viewed from a right lower front side of the vehicle body.

FIG. 25 is a perspective view of the insulator block with the female-side terminals accommodated therein, as viewed from a left upper rear side.

35 FIG. 26 is a sectional view of the insulator block, as viewed from the left side of the vehicle body, at contact parts of the female-side terminals.

FIG. 27A is a sectional view showing the positional relationship between the male-side terminal and the female-side terminal, as viewed from the rear side of the vehicle body.

5 FIG. 27B is a sectional view showing the positional relationship between the male-side terminal and the female-side terminal, as viewed from the rear side of the vehicle body.

10 FIG. 27C is a sectional view showing the positional relationship between the male-side terminal and the female-side terminal, as viewed from the rear side of the vehicle body.

15 FIG. 27D is a sectional view showing the positional relationship between the male-side terminal and the female-side terminal, as viewed from the rear side of the vehicle body.

20 FIG. 27E is a sectional view showing the positional relationship between the male-side terminal and the female-side terminal, as viewed from the rear side of the vehicle body.

FIG. 28 shows an enlarged view of an essential part of FIG. 27E.

FIG. 29 is a right side view of an essential part of a motorcycle provided with an under frame.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, a preferred mode for carrying out the present invention will be described below, referring to the drawings. FIG. 1 is a right side view of an essential part of an electric vehicle provided with a power supply device for electric vehicle according to an embodiment of the present invention; FIG. 2 is a left side view of the same; and FIG. 3 is a perspective view of an essential part of the electric vehicle as viewed from a right front side. A rider seat and cowls and the like are omitted from the drawings, for easy understanding of the configuration of an essential part. In the drawings to be referred to in the following, the front side of the electric vehicle 1 will be denoted by reference sign Fr, the rear side by reference sign Rr, the left side by reference sign L, the right side by reference sign R, and the upper side by reference

- 10 -

sign Up. Unless especially defined, the directions (sides) herein are the directions (sides) with respect to the electric vehicle.

5 The electric vehicle 1 is a motorcycle of an off-road type in which an electric motor is used as a drive source (hereafter, description will be made taking the "motorcycle" as the "electric vehicle"). The motorcycle 1 has a main frame 3 which is joined to a head pipe 2 at a front end portion thereof and which extends downwardly rearward. The main frame 3 has a monocoque body composed of an upwardly curved single pipe. The material of the main frame 3 is arbitrary, and the
10 main frame 3 may be integrally molded with the head pipe 2.

To a lower rear portion of the main frame 3, pivot plates 4 are joined which are provided with a pivot 5 and a pivot 6 extending in the vehicle width direction. Of the pivot 5 and the pivot 6, the pivot 5 located on the upper side supports a pair of
15 left and right swing arms 7 in a vertically swingable manner. The pivot 6 located below the pivot 5 supports a rear brake pedal 8, which is disposed on the right side of the electric motorcycle 1, in a vertically swingable manner. At a lower end portion of the pivot plate 4, a side stand (not shown) disposed on the left side of the electric motorcycle 1 can be pivotally supported.

20

A pair of left and right seat frames 9 and cushion front support brackets 10 are joined to a curved intermediate portion of the main frame 3. The cushion front support brackets 10 are reinforced with a stay 12. The seat frames 9 are joined to the main frame 3 at their front end portions, and extend toward the rear side of the
25 vehicle body. Sub frames 11 are provided which are each joined to the main frame 3 and the seat frame 9 at front and rear ends thereof. The seat frames 9 are supported from below and reinforced by the sub frames 11.

Rear wheel support plates 13 are joined respectively to rear portions of the pair
30 of left and right swing arms 7. Furthermore, rear end portions of a pair of left and right sub pipes 14 extending toward the front side of the vehicle body are joined to upper portions of the rear wheel support plates 13. Between the sub pipe 14 and the swing arm 7, a connection tube 15 is provided which interconnects them. A cushion support rear bracket 16 is joined to an upper portion of the sub pipe 14. A rear
35 cushion 17 is provided in the state of being pivotally supported by the cushion support front brackets 10 and the cushion support rear brackets 16. A rider seat (not

- 11 -

shown) is mounted on a part ranging from the seat frames 9 and a front portion of the main frame 3.

5 A driving device 18 and a battery pack 19 as a power supply device located forwardly of the driving device 18 are provided on the main frame 3. The battery pack 19 includes a plurality of battery cells (not shown) accommodated in a battery case 20. The driving device 18 includes an electric motor 21 and a reduction gear 22, and is covered with a driving device case (hereafter referred to as "motor case") 23. Incidentally, since the driving device 18 is covered with the motor case 23, it should
10 be drawn in broken lines; however, the driving device 18 is drawn in solid lines, for avoiding complexity and for better understanding of its shape. The motor case 23 is connected to hanger brackets 24 and 25 and a pivot plate 4, whereby it is suspended at three positions. The battery pack 19 includes: a battery pack holding stay 27 connected to a lower portion of the motor case 23 and extending forward from the
15 motor case 23; a battery pack cover 28 fixed to the battery pack holding stay 27; and a terminal base 29 fixed to a lower portion of the battery pack cover 28.

A lock device support stay 30 and a PDU bracket 31, which protrude downward, are joined to front portions of the main frame 3. A lock device 32 is
20 mounted to the lock device support stay 30 located immediately forwardly of the battery pack 19, and a PDU (power drive unit) 33 is mounted to the PDU bracket 31 located near the head pipe 2. The PDU 33 is supplied with electric power from the battery pack 19, and performs digital phase control for the electric motor 21 in accordance with battery information (residual battery power, etc.), detection signals
25 from various switches and sensors and the like provided on the motorcycle 1, etc.

A handle 34 to be used for carrying the battery pack 19 is provided at an upper portion located on the vehicle front side of the battery case 20 of the battery pack 19. The handle 34 is formed with a lock pin engagement part for engagement with a lock
30 pin projecting from the lock device 32 (the lock pin and the lock pin engagement part will be detailed later).

A drive-side sprocket 36 is connected to an output shaft 35 of the reduction gear 22. A rear wheel WR as a drive wheel is supported on the rear wheel support plates
35 13 through a rear axle 37, and a driven-side sprocket 38 is connected to the rear axle 37. A drive chain 39 is arranged between the drive-side sprocket 36 and the driven-side sprocket 38, and power of the electric motor 21 reduced in speed by the

- 12 -

reduction gear 22 is transmitted to the rear axle 37 through the driven-side sprocket 38. The drive chain 39 is accompanied by a chain cover 61 (see FIG. 1) covering an upper portion thereof. Incidentally, the rear axle 37 and the driven-side sprocket 38 are interconnected through a one-way clutch so that power of the electric motor 21 is transmitted to the rear wheel WR only in the direction for forward traveling of the motorcycle 1.

A step bar 42 is extended in the vehicle width direction, and steps 40 and 41 on which to put the driver's feet are attached to the right and left ends of the step bar 42. The step bar 42 is attached to a bottom surface of the motor case 23 through a bracket 43. The rear brake pedal 8 supported on the pivot 6 includes a front arm part 801 operated by the driver's foot, and a rear arm part 802 which is connected through a brake cable 45 to an operation arm 44 of a rear brake (not shown) provided on the rear axle 37.

On the head pipe 2, a steering shaft (not shown) extending to penetrate the head pipe 2 along the vertical direction is turnably supported. A pair of vertically extending front forks 51 are connected to a top bridge 49 and a bottom bridge 50 which are connected respectively to upper and lower portions of the steering shaft. A front axle 52 extending in the vehicle width direction is supported by the lower ends of the front forks 51, and a front wheel WF is rotatably supported on the front axle 52. A front fender 53 located on the upper side of the front wheel WF is mounted to the front forks 51.

A steering handle 48 supported on the top bridge 49 is provided with an accelerator grip 55. An accelerator cable 56 is connected to the accelerator grip 55. A turning amount of the accelerator grip 55 (accelerator position) is transmitted through the accelerator cable 56 to an accelerator position sensor (APS) 57 provided inside the motor case 23.

FIG. 4 is a perspective view of the lock device 32 as viewed from a right upper rear side of the vehicle body, and FIG. 5 is a sectional view showing a section passing through the lock pin of the lock device 32, as viewed from the right side of the vehicle body. The lock device 32 includes a cylinder part 321 having a hollow cylindrical shape, a lock pin guide 322 projecting to a side portion (on the rear side of the vehicle body) of the cylinder part 321, and a lock pin 323 as a movable part

- 13 -

extending in a direction orthogonal to the cylinder part 321 while penetrating the lock pin guide 322.

The cylinder part 321 is formed in its right end portion with a key hole 324, and a key (not shown) is inserted in the key hole 324. A configuration in conjunction with the turning direction of the key is adopted wherein when the key is turned in a power supply turning-ON direction (for example, clockwise), the lock pin 323 is protruded from the cylinder part 321, and when the key is turned to a power supply turning-OFF side, the lock pin 323 is retracted to the cylinder part 321 side.

A mechanism for conversion of the rotating motion of the key into forward-rearward motion of the lock pin 323 includes an inner tube disk 325 provided coaxially with the cylinder part 321, as shown in FIG. 5. In this mechanism, an eccentric shaft 326 provided on the inner tube disk 325 is engaged with an end portion (an annular portion protruding into the inside of the cylinder) 327 of the lock pin 323, whereby the lock pin 323 can be protruded and retracted according to the eccentricity amount of the eccentric shaft 326 relative to the rotational center 32c of the inner tube disk 325. The lock device 32 is mounted to the lock device support stay 30, with such a positioning that the lock pin 323 being protruded is loosely fitted in an engagement hole 62 formed in the battery case 20. The advancing-and-retracting mechanism for the lock pin 323 is not restricted to the one having the structure shown in FIG. 5, and can be replaced by other known one.

The battery case 20 is preferably formed from a resin, from the viewpoint of lighter weight and easier production. For reinforcing the engagement hole 62, therefore, a reinforcement ring 621 made of metal, for example, may be fitted in the inner circumference of the engagement hole 62.

FIG. 6 is a perspective view of the battery pack 19 accommodated in the battery pack cover 28, as viewed from a right upper rear side of the motorcycle 1. The battery pack cover 28 has a shape as if obtained by removal of one surface (a surface on the right side of the vehicle body) of six surfaces constituting a substantially rectangular parallelepiped shape. A depth D (the dimension in the left-right direction of the vehicle body) of the battery pack cover 28 is so set that the battery pack cover 28 covers only roughly a half 19L, located on the left side of the vehicle body, of the battery pack 19. Therefore, roughly a half 19R, on the right side of the vehicle body,

- 14 -

of the battery pack 19 is not covered by the battery pack cover 28, so that the right-side external appearance of the battery pack 19 can be visually confirmed externally.

The terminal base 29 is fixed to a bottom portion of the battery pack cover 28.
 5 The terminal base 29 is provided with a battery pack support part 295 which is engaged with a front-rear surface lower portion on the battery pack 19 side at a right-side portion of the battery pack 19, namely, at its right half 19R not covered with the battery pack cover 28.

10 An upper portion of the right half 19R of the battery pack 19 extends to the upper side relative to an upper end portion of the battery pack cover 28. This upper-side extension part 19P is provided with a recess which is recessed to the right side from a part on the vehicle body left side. An upper wall forming the recess constitutes a grip part of the handle 34 to be hooked by finger tips. The recess and
 15 the grip part constituting the upper wall of the recess will be described later, referring to FIGS. 10 and 13, etc.

The battery case 20 of the battery pack 19 is composed of a front part 20F and a rear part 20Rr into which the battery case 20 is bisected in the vehicle longitudinal
 20 direction. A side surface of the front part 20F constituting the upper-side extension part 19P is formed with the engagement hole 62 in which the lock pin 323 protruding from the lock device 32 is to be loosely fitted. The engagement hole 62 is bored in a wall surface of the front part 20F, which is orthogonal to the grip part (described later) of the handle 34, of the battery case 20.

25

FIG. 7 is a perspective view of the terminal base 29 fixed to the battery pack cover 28, FIG. 8 is a perspective view of the terminal base 29 with an insulator board 64 fitted therein, as viewed from a right upper rear side of the vehicle body, and FIG. 9 is a perspective view of the terminal base 29 as viewed from a left lower rear side
 30 of the vehicle body. The terminal base 29 includes: a base 292 provided with an opening 291 into which to fit the insulator board 64 having mounted thereto a plurality of male-side terminals 63 as vehicle body side terminals arrayed in a row along the vehicle longitudinal direction; mounting parts 293 and 294 protruding to the upper side of the base 292 and distributed in the vehicle longitudinal direction at
 35 a vehicle body left-side end portion; and a battery pack support part 295 extending to the vehicle body right side in relation to the base 292. Between the opening 291

- 15 -

and the battery pack support part 295, a projected part 29a for engagement with a bottom surface of the battery case 20 is formed on the base 292.

5 The mounting parts 293 and 294 are provided with inner circumferential surfaces 29b and 29c (see FIG. 9) to be located over bosses 281 and 282 formed at a vehicle body left side surface of the battery pack cover 28. The mounting parts 293 and 294 are formed with bolt passing holes 296 and 297 bored in the vehicle width direction. When bolts or setscrews (not shown) which can be passed through the bolt holes 296 and 297 from the vehicle body right side are screw engaged with screw holes (not shown) formed in the bosses 281 and 282 protruding from the battery pack cover 28, the terminal base 29 can be fixed to the battery pack cover 28.

15 On vehicle-longitudinal-directionally both sides of a vehicle body right-side edge of the opening 291, upper guides 298, 298 are protruded along the upper surface of the base 292. In addition, the vehicle body right-side edge of the opening 291 is provided with a lower guide 299 protruding along the lower surface of the base 292 between the upper guides 298, 298. On the other hand, on vehicle-longitudinal-directionally both sides of a vehicle body left-side edge of the opening 291, a lower guide 301 is protruded along the lower surface of the base 292. Further, at a vehicle-longitudinal-directionally central portion of the vehicle body left-side edge of the opening 291, a stopper 300 is projected from the upper surface of the base 292.

25 A harness 65 led out to the driving device 18 side is connected to the male-side terminals 63. In the case of mounting the insulator board 64 to the base 292, the harness 65 is passed through the opening 291 from the upper side of the base 292 of the terminal base 29 to the lower side of the base 292. Then, while clamping one edge (the edge on the vehicle body right side) of the insulator board 64 between the upper guides 298, 298 and the lower guide 299, the lower surface of another edge (the edge on the vehicle body left side) of the insulator board 64 is brought into contact with the lower guide 301, and the stopper 300 is engaged with the upper surface and thereby fixed. In FIG. 7, the battery pack cover 28 is formed with a rib 283 at a position between the bosses 281 and 282 and near the base 292. The rib 283 is protruding from a wall part (left side wall 285) toward the right side. The position of the rib 283 relative to the terminal base 29 mounted in the battery pack cover 28 is so set that the rib 283 can cover the left edge of the insulator board 64 from above. The rib 283 contributes to firmer positioning of the insulator board 64, which is

- 16 -

locked to the terminal base 29 by the stopper 300, whereby the insulator board 64 is restrained from moving upward.

5 The battery support part 295 is provided with two end engagement projections 59, 59 aligned in the vehicle longitudinal direction, and with a central engagement projection 66 located between the end engagement projections 59, 59. The end engagement projections 59, 59 and the central engagement projection 66 are "vehicle body side engagement parts," and are provided at positions deviated to one side (in this example, to the right side) from the vehicle body center in the vehicle width
10 direction. The central engagement projection 66 is provided with a peak portion 66P including a cylindrical stopper 66E protruded to the sides of the end engagement projections 59, 59 and engaged with the battery case 20 as will be described later. In spaces formed between the end engagement projections 59, 59 and the central engagement projection 66, ribs 711 and 712 (described later referring to FIG. 11)
15 formed on a bottom portion of the battery case 20 are to be inserted. At the time of mounting the battery pack 19 to the terminal base 29, mutually facing side surfaces 59S, 59S of the end engagement projections 59, 59 are contacted by side surfaces of the ribs 711 and 712 on the battery case 20 side which are inserted between the end engagement projections 59, 59 and the central engagement projection 66. Thus, the
20 side surfaces 59S, 59S have a function to guide the ribs 711 and 712 at the time of mounting the battery pack 19 to the terminal base 29, and to position (align) the battery pack 19 in the vehicle longitudinal direction.

25 The upper portion shapes of the peak portions 59P and 66P of the end engagement projections 59, 59 and the central engagement projection 66 are the same part-of-circle shape, and they are aligned in the front-rear direction of the battery pack 19. Vehicle body right-side foot portions of the end engagement projections 59, 59 and the central engagement projection 66 form a shelf 67, whereby the end engagement projections 59, 59 and the central engagement projection 66 are
30 interconnected at their lower portions. As will be described later, the shelf 67 provides a base on which the battery pack 19 can be tentatively put at the time of mounting or detaching the battery pack 19 to or from the battery pack cover 28.

35 FIG. 10 is a perspective view of the battery pack 19 as viewed from a left upper rear side of the vehicle body, and FIG. 11 is a perspective view of the battery pack 19 as viewed from a left lower front side of the vehicle body. In FIGS. 10 and 11, the

- 17 -

front part 20F and the rear part 20Rr of the battery case 20 are coupled to each other by bolts or setscrews, to form the battery case 20 as a sealed casing.

At a circumferential edge of a side surface (a surface located on the vehicle body front side when the battery pack 19 is mounted on the vehicle) of the front part 20F of the battery case 20, notches 68 as relief portions for passing bolts or setscrew therethrough are formed in a plurality of positions. In addition, at a circumferential edge of the rear part 20Rr corresponding to the notches 68, screw holes 90 (described later referring to FIG. 13) with which the bolts or setscrews passed from the front part 20F side are to be screw engaged are formed. In order not to elongate the screw holes 90 more than necessary, notches 69 are formed at the circumference of the rear part 20Rr. The screw holes are formed in the part near the front part 20F exclusive of the notches 69.

Lower corner parts 201 and 202 of the battery case 20 are recesses which are cut out so as to avoid the mounting parts 293 and 294 formed on the terminal base 29. Besides, at lower side surfaces (surfaces located on the vehicle body left and right sides when the battery pack 19 is mounted on the vehicle) of the battery case 20, end engagement recesses 60 adapted to the end engagement projections 59, 59 of the battery support part 295 and a central engagement recess 70 adapted to the central engagement projection 66 of the battery support part 295 are formed. The end engagement recesses 60 and the central engagement recess 70 correspond to "battery case side engagement part." The end engagement recesses 60 and the central engagement recess 70 are partitioned by ribs 71 and 72 projected from a bottom portion of the battery case 20. The ribs 71 and 72 are parallel to joint surfaces 20J of the front part 20F and the rear part 20Rr of the battery case 20. The ribs 71 and 72 each have two parts 711 and 712, and 721 and 722 which are bent to the direction orthogonal to the joint surfaces 20J at an intermediate position in the vehicle width direction, thereby forming a step.

Of the parts 711 and 712 of the rib 71 and the parts 721 and 722 of the rib 72, those parts 711 and 721 which are located on the outer side make contact with the inside surfaces 59S, 59S (see FIG. 8) of the end engagement projections 59, 59. On the other hand, those parts 712 and 722 which are located on the inner side make contact with a downwardly extending outside portion of the peak portion 66P. The parts 711 and 712 of the rib 71 make contact with the inside surfaces 59S, 59S of the battery case 20, to function as a guide for restraining the vehicle-longitudinal-directional

- 18 -

position of the battery pack 19 relative to the terminal base 292. A link part 713 linking the parts 711 and 712 of the rib 71 to each other and a link part 723 linking the parts 721 and 722 to each other are provided. The link parts 713 and 723 are each arc-shaped in side view of the battery pack 19, and their inner circumferential surfaces (surfaces located near the upper side of the battery pack 19) are engaged with the stopper 66E of the central engagement projection 66 at a position where the battery pack 19 is mounted on the terminal base 29.

To a bottom portion of the battery case 20, an insulator block 74 is mounted. The insulator block 74 is provided with female-side terminals 73 (described later referring to FIGS. 24 to 26, etc.) into which to insert the male-side terminals 63 attached to the terminal base 29. The insulator block 74 is formed from an electrically insulating and elastic material such as rubber or resin. The insulator block 74 is held between the front part 20F and the rear part 20Rr of the battery case 20, without using any fastening member such as bolts or setscrews. The mode of holding will be described later. The front part 20F of the battery case 20 is provided in its bottom portion with a cutout 75 into which to fit the projected part 29a formed on the terminal base 292. The cutout 75 is open on one side. The cutout 75 may be a hole (fitting hole) into which to fit the projected part 29a.

FIG. 12 is a plan view of the front part 20F of the battery case 20, as viewed from a vehicle-width-directional center side, FIG. 13 is a plan view of the rear part 20Rr of the battery case 20, as viewed from the vehicle-width-directional center side, and FIG. 14 is a view of the battery case as viewed from the left side of the vehicle body. The front part 20F and the rear part 20Rr of the battery case 20 form an upper chamber 20U, a middle chamber 20M and a bottom chamber B (see FIG. 14) when combined with each other. Incidentally, FIG. 13 shows a condition where the insulator block 74 with the female-side terminals 73 accommodated therein is held in the bottom chamber 20B.

The upper chamber 20U is formed as a recess which is surrounded by a front wall 76 and a rear wall 77, an upper wall 78 constituting the grip part of the handle 34, a vertical wall 79 extending downward from the upper wall 78, and an upper wall 80 of the middle chamber 20M, and which is opened on one side (the vehicle-width-directionally left side). The grip part, or the upper wall 78, has a part-of-cylinder shaped projection 781 which extends in the front-rear direction of the battery pack 19 (substantially the same direction as the vehicle longitudinal

- 19 -

direction), on which the operator's fingers are to be hooked, and which is bulged to the lower side. The engagement hole 62 in which to fit the lock pin is formed in the front wall 76, orthogonal to the grip part 78, of the front part 20F at a position deviated from the grip part 78.

5

The middle chamber 20M is a chamber in which to accommodate a plurality of battery cells (not shown). The middle chamber 20M is surrounded by the front wall 76 and the rear wall 77, the upper wall 80, left and right walls 82 and 83, and a bottom wall (common with an upper wall of the bottom chamber 20B) 84.

10

The bottom chamber 20B is surrounded by the front wall 76 and the rear wall 77, the upper wall (common with the bottom wall of the middle chamber 20M) 84, a bottom wall 85, a left wall 86 and a right wall 87. The bottom chamber 20B is a chamber in which to accommodate the female-side terminals 73, the insulator block 74, and a fuse 99. The fuse 99 will be described later, referring to FIG. 17.

15

The front part 20F of the battery case 20 is provided with screw passing holes 89 through which bolts or setscrews can be passed. The rear part 20Rr of the battery case 20 is formed with screw holes 90 at positions corresponding to the screw passing holes 89. In addition, pins 91 for positioning are erected on either one (here, the front part 20F) of the front part 20F and the rear part 20Rr of the battery case 20, and the other (here, the rear part 20Rr) is formed with pin holes 92 in which to fit the pins 91.

20

25

In relation to the walls 80, 82, 83 and 84 forming the middle chamber 20M, it is recommendable to dispose a packing or seal at the joint surfaces 20J of the front part 20F and the rear part 20Rr.

30

The front part 20F of the battery case 20 forming the bottom chamber 20B is provided with: a rib 94a projecting from the upper wall 84 into the bottom chamber 20B; a rib 95a projecting from the left wall 86 into the bottom chamber 20B; a rib 96a projecting from the bottom wall 85 into the bottom chamber 20B; and a rib 97a projecting from the front wall 76 into the bottom chamber 20B.

35

On the other hand, the rear part 20Rr of the battery case 20 which forms the bottom chamber 20B is provided with: a rib 94b projecting from the upper wall 84 into the bottom chamber 20B; a rib 95b projecting from the left wall 86 into the

- 20 -

bottom chamber 20B; a rib 96b projecting from the bottom wall 85 into the bottom chamber 20B; and a rib 97b projecting from the rear wall 77 into the bottom chamber 20B. The ribs 95a and 95b, the ribs 96a and 96b, and the ribs 97a and 97b, are set at such positions as to be opposed to each other in the condition where the front part 20F and the rear part 20Rr are combined with each other; besides, these ribs cooperate with each other in holding the female-side terminals 73 and the insulator block 74 (described later).

Furthermore, the front part 20F of the battery case 20 which forms the bottom chamber 20B is formed with a boss 98a projecting from the front wall 76. On the other hand, the rear part 20Rr of the battery case 20 is provided with ribs 98b, 99b, and 100b which project into the bottom chamber 20B from the upper wall 84 and the rear wall 77 forming the bottom chamber 20B. The ribs 98b, 99b and 100b cooperate with the boss 98B in holding a fuse 99 (described later) in the condition where the front part 20F and the rear part 20Rr are combined with each other.

The front part 20F and the rear part 20Rr of the battery case 20 forming the bottom wall 85 of the bottom chamber 20B are formed respectively with cutouts 101 and 102 for receiving an end portion of the insulator block 74. When the front part 20F and the rear part 20Rr are combined with each other, the cutouts 101 and 102 form a substantially rectangular opening 103 (see FIG. 15) in which to receive and hold an end portion of the insulator block 74.

FIG. 15 is an enlarged view of an essential part of the battery case 20. As shown in FIG. 15, the cutouts 101 and 102 formed respectively in the joint surfaces 20J of the front part 20F and the rear part 20Rr form the opening 103 in a bottom portion of the battery case 20.

FIG. 16 is an enlarged perspective view of a lower portion of the rear part 20Rr of the battery case 20, and FIG. 17 is an enlarged perspective view of a lower portion of the rear part 20Rr in the condition where the fuse 99 and the male-side terminals 73 and the insulator block 74 are mounted in position. As understood from FIG. 16, the ribs 94b, 95b and 96b are each in a part-of-cylinder shape, whereas the rib 97b is cross-shaped as viewed in the vehicle longitudinal direction in the condition where the battery case 20 is mounted to the vehicle body.

- 21 -

On the other hand, the ribs 98b and 99b extend in the vehicle longitudinal direction in the condition where the battery case 20 is mounted to the vehicle, and they are disposed in parallel to each other. The rib 100b is composed of: a part x1 which is parallel to the ribs 98b, 99b and is shorter than the ribs 98b, 99b in height
5 (dimension along the vehicle longitudinal direction in the condition where the battery case 20 is mounted to the vehicle body); and a part x2 which is longer than the part x1 in height and which is T-shaped as viewed in the vehicle longitudinal direction.

10 In the mounted state as shown in FIG. 17, the fuse 99 is seated on the part x1 of the rib 100, and is held between the ribs 98b, 99b and the T-shaped part x2 of the rib 100b. In addition, the insulator block 74 is seated on the rib 97b shown in FIG. 16, and is held between the part-of-cylinder shaped members constituting the ribs 94b, 95b and 96b.

15 The insulator block 74 holds the female-side terminals 73, and accommodates electric wires 771 and 772 and a signal line 773 (unitedly shown as "harness 105") led out from the female-side terminals 73 toward the fuse 99 side.

20 The fuse 99 and the insulator block 74 are adjacent to each other, and the harness 105 connected to the female-side terminals 73 is led out to the fuse side. Therefore, the length of the harness 105 between the female-side terminals 73 and the fuse 99 can be shortened.

25 The insulator block 74 is provided with flange parts 741 and 742 by which the circumferential edge of the opening 103 formed by combination of the cutouts 101 and 102 provided in the bottom wall 85 of the battery case 20 is clamped from the inside and the outside of the bottom chamber 20B. The outer circumferential shape of that part 743 (see FIG. 25) of the insulator block 74 which is located between the
30 flanges 741 and 742 is set to have such dimensions as to fit to the inner circumference of the opening 103.

In this manner, the fuse 99 and the insulator block 74 are simultaneously held in the battery case 20 by combination or assembly of the front part 20F and the rear part
35 20Rr of the battery case 20, without using any fastening part such as bolts or setscrews.

- 22 -

Now, the procedure and operations in mounting the battery pack 19 to the battery pack cover 28 will be described below. FIGS. 18A to 18D are views showing the positional relationship between the battery pack 19 and the terminal base 29 at the time of mounting the battery pack 19 to the battery pack cover 28. FIGS. 19A to 19D are views showing the positional relationship between the battery pack cover 28 as well as the terminal base 29 and the battery pack 19, as viewed from a right upper rear side of the vehicle body, corresponding respectively to FIGS. 18A to 18D. At the time of an operation of mounting or detaching the battery pack 19, the motorcycle 1 is left standing in a leftwardly inclined posture by use of the side stand. Therefore, the terminal base 29 is not set upright but is inclined to the left side by an angle of about 12 degrees, for example. For simplification, however, the motorcycle 1 is shown to be set upright in FIGS. 18A to 18D and FIGS. 19A to 19D.

In FIGS. 18A to 18D, the battery pack support part 295 composed of the end engagement projections 59, 59 and the central engagement projection 66 has slant surfaces 59d, 66d formed to be slanted down toward the right side of the vehicle body from a peak portion 29P (composed of the peak portions 59P, 66P). The slant surfaces 59d, 66d have an angle α (for example, the angle α is 35 degrees) relative to the base 292.

First, in FIGS. 18A and 19A, the battery pack 19 is brought closer to the terminal base 29 from a right upper side of the vehicle body. It is recommendable to operate the battery pack 19 while gripping the handle 34 by the right hand and supporting the part 19R, on the side where the handle 34 is formed, by the left hand. In this case, the battery pack 19 is brought closer to the terminal base 29 in such a manner that the vertical walls of the end engagement recesses 60 and the central engagement recess 70 (the vertical wall 601 of the end engagement recess 60 is taken as a representative of these vertical walls in the description here) formed by the rib 71 and the rib 72 provided at a bottom portion of the battery case 20 are substantially along the slant surfaces 59d, 66d of the battery pack support part 295 and that the peak portion 29P of the battery pack support part 295 of the battery pack support part 295 is opposed to the end engagement recesses 60 and the central engagement recess 70 from the lower side of the battery pack 19.

Incidentally, as has been described referring to FIG. 11, the rib 71 is composed of the parts 711 and 712, while the rib 72 is composed of the parts 721 and 722. In

- 23 -

addition, the peak portion of the battery pack support part 295 is composed of the peak portions 59P and 66P.

In the posture as shown in FIG. 18A and FIG. 19A, the battery pack cover 28 is covering only the depth side of the terminal base 29 (the side which is the left side of the vehicle body and on which the male-side terminals 63 are provided) and is not covering the battery pack support part 295. This permits the operator to clearly recognize visually the positional relationship between the end engagement projections 59 and the end engagement recesses 60.

Next, starting from the posture as shown in FIGS. 18A and 19A, the hand supporting the battery pack 19 is slightly loosened. As a result, the battery pack 19 slides downward on the vertical wall 601 along the slant surfaces 59d, 66d, to be moved into the position as shown in FIGS. 18B and 19B. In the posture (tentatively placed posture) as shown in FIGS. 18B and 19B, the peak portion 29P of the battery pack support part 295 has reached a location at which it makes contact with the internal surface of the uppermost portions of the end engagement recesses 60. In this instance, a surface 19c formed by cutting a corner (corner located on the right side of the vehicle body) of a bottom portion of the battery pack 19 makes contact with the upper surface of the shelf 67 of the battery pack support part 295. Incidentally, at a lower surface of the battery case 20 formed to be roughly rectangular parallelopipes in general shape, the slant surface 19c is extending from lower open end portions of the end engagement recess 60 and the central engagement recess 70 toward that one of surfaces adjacent to the lower surface which is adjacent on the side of protrusion of the shelf 67.

Therefore, in this position, it is ensured that even if the operator further loosens the hand supporting the battery pack 19, the battery pack 19 is tentatively placed on the terminal base 29 by only lightly supporting the battery pack 19. Thus, during the operation of mounting the battery pack 19 which has a comparatively heavy weight, the hand gripping the battery pack 19 can once been loosened, which is effective in alleviating the burden in the mounting operation.

Subsequently, an operation is conducted by which the battery pack 19 being tentatively placed in the inclined posture is tilted up toward the left side of the vehicle body, to be put into an upright state. During this operation, as shown in FIGS. 18C and 19C, the posture of the battery pack 19 relative to the terminal base 29

is changed with corner portions 60a of the end engagement recesses 60 as a fulcrum, and the surface 19c is separated from the shelf 67 of the terminal base 29. The wall parts forming the end engagement recesses 60 each have a portion shaped to roughly coincide with the curve along the arc-shaped locus along which the peak portion 29P is moved in the course of transition of the battery pack 19 from the tentatively placed posture to the upright posture, in order not to hamper the movement of the battery pack 19 along the arc-shaped locus.

In the position as shown in FIGS. 18C and 19C, the male-side terminals 63 projecting to the upper side of the terminal base 29 start being engaged with the insulator block 74 accommodating the female-side terminals 73 of the battery pack 19. The tips of the male-side terminals 63 are beveled on the left side of the vehicle body, namely, on the depth side in the battery insertion direction. This ensures that the tips of the male-side terminals 63 are prevented from abutting against a corner portion of the opening of the insulator block 74 (a corner portion of the opening by which the male-side terminals 63 are guided to an insertion port for insertion into the female-side terminals 73). The detailed shape of the male-side terminals 63 will be described later referring to FIGS. 21 and 23, etc.

In FIGS. 18D and 19D, the battery pack 19 is seated on the terminal base 29. In other words, the battery pack 19 is in a completely mounted posture relative to the vehicle body. In this position, the bottom surface of the battery pack 19 is in contact with the upper surface of the base 29, and the male-side terminals 63 are electrically in contact with the female-side terminals 73. In this position, besides, the engagement hole 62 formed in the front wall 76 of the handle 34 of the battery pack 19 is opposed to the lock pin 323 of the lock device 32. Here, when the key is inserted into the key hole of the lock device 32 and turned to a predetermined lock position, the lock pin 323 is protruded and fitted into the engagement hole 62. As a result, the battery pack 19 situated on the terminal base 29 is locked to the main frame 3 of the motorcycle 1.

In the position where the battery pack 19 is seated on the terminal base 29, the stopper 66E projecting from the peak portion 66P of the central engagement projection 66 of the battery pack support part 295 is in engagement with the inner circumferential surfaces (upper side surfaces) of the link part 713 between the parts 711 and 712 of the rib 71 and the link part 723 (see FIG. 11) between the parts 721 and

722 of the rib 72. This ensures that the battery pack 19 is restrained in position in the vertical direction.

Further, the position of the battery pack 19 on the terminal base 29 in the direction parallel to the upper surface of the base 292 is restrained by those contact portions of the end engagement recesses 60, 60 and the central engagement recess 70 which make contact with the end engagement projections 59, 59 and the central engagement projection 66. In addition, the position is restrained also by the fitting between the cutout 75 formed in a bottom portion of the front part 20F of the battery case 20 and the projected part 29a on the terminal base 29.

At the time of detaching the battery pack 19 from the terminal base 19 and the battery pack cover 28, operations reverse to the above-mentioned operations are carried out. Specifically, the lock device 32 is operated with the key, to pull out the lock pin 323 from the engagement hole 62. This results in that the battery pack 19 can be tilted to the right side of the vehicle body. When the upper side of the battery pack 19 is tilted to the vehicle body right side by gripping the handle 34 and the battery pack 19 is pulled upward, therefore, the battery pack 19 can be detached from the motorcycle 1.

20

FIG. 20 is a front view (as viewed from the right side of the vehicle body) of a male-side terminal unit, FIG. 21 is a perspective view (as viewed from a rear right lower side of the vehicle body) of the male-side terminal unit, FIG. 22 is a plan view of the male-side terminal unit, and FIG. 23 is a side view (as viewed from the front side of the vehicle body) of the male-side terminal unit. In FIGS. 20 to 23, plural (here, five) male-side terminals 63 are provided, and they are arrayed in the vehicle longitudinal direction when the battery pack 19 is mounted to the motorcycle 1.

Of the plurality of male-side terminals 63, two are power terminals 63a and 63e which are connected respectively to the plus side and the minus side of the battery pack 19, and the remaining ones are signal line terminals 63b, 63c and 63d which are connected to signal lines. The power terminals 63a, 63e are so disposed that their tips are located above the tips of the signal line terminals 63b, 63c and 63d. This ensures that the power terminals 63a, 63e are electrically connected to the female-side terminals 73 earlier than the connection of the signal line terminals 63b, 63c and 63d. This contributes to enhancement of durability of the power terminals 63a, 63e and the female-side terminals 63.

35

- 26 -

As shown in FIG. 23, as for the tip of the male-side terminal 63, the corner 63f on the vehicle-width-directionally left side is obliquely beveled at an angle θ relative to the lengthwise direction of the male-side terminal 63. Besides, the corner 63F on the vehicle-width-directionally right side is beveled at an angle θ_2 , greater than the angle θ , relative to the lengthwise direction of the male-side terminal 63. Incidentally, the bevel length L at the corner 63f is greater than the bevel length L2 at the corner 63F. In other words, the corner 63f is cut more greatly than the corner 63F. Thus, the tip of the male-side terminal 63 is tapered off as viewed in the vehicle rear-side direction.

The bevel at the corner 63F is provided so that at the time of connection of the male-side terminal 63 to the female-side terminal 73, the contact of the male-side terminal 63 to the female-side terminal 73 is started not with a point but with a surface. On the other hand, the bevel at the corner 63f is provided for the purpose of securing a clearance and preventing the tip of the male-side terminal from touching or being caught on the corner of the insulator block 74, at the time of starting the contact of the male-side terminal 63 with the female-side terminal 73.

The number of the signal line terminals is not limited to three, and may be increased or decreased, as required. Or, alternatively, the number of the signal line terminals may be fixed, for example, to five, and all or part of them may be solely used according to situations, for example, the model and grade, etc. of the motorcycle 1.

The male-side terminal 63 is provided to orthogonally penetrate the insulator board 64. To that portion of the male-side terminal 63 which is located below the insulator board 64, electric wires 651 and 652 or signal lines 653, 653, 653 branched from the harness 65 are connected.

The insulator board 64 includes a main part 641 to be fitted into the opening 291 formed in the terminal base 29, a right-side edge 642 projecting from the main part 641 to the vehicle body right side to be clamped between the main part 641 and the upper guides 298 of the terminal base 29, and a left-side edge 643 projecting from the main part 641 to the vehicle body left side to be engaged with the stopper 300 extending from the terminal base 29. The left-side edge 643 is formed with a recess 644. The tip of the stopper 300 comes around to the upper side of the left-side edge

- 27 -

643 of the insulator board 64 while avoiding the recess 644. The insulator board 64 is fixed by being clamped between the stopper 300 and the lower guide 301 of the terminal base 29 (see FIGS. 8 and 9, as well).

FIG. 24 is a perspective view of the insulator block 74 with the female-side terminals 73 accommodated therein, as viewed from a right lower front side of the vehicle body, FIG. 25 is a perspective view of the same as viewed from a left upper rear side, and FIG. 26 is a sectional view of the insulator block 74, as viewed from a left side of the vehicle body, at contact parts of the female-side terminals 73.

In FIGS. 24 to 26, the insulator block 74 is formed in its upper portion with plural (in this example, five) openings 745 in which to insert the plurality of male-side terminals 63 (63a to 63e). The opening 745 is rectangular in cross section, and has taper surfaces such that the aperture area is narrowed toward the female-side terminal 73 located in the depth. The female-side terminal 73 is located on the side where the aperture area is narrowed, of the opening 745. The female-side terminal 73 has a connection part 633 which extends to the upper side from two connection parts 632 and 632 for clamping from two sides the male-side terminal 63 inserted as shown in FIG. 26 and which is connected to electric wires 771 and 772 or a signal line 773. For avoiding intricateness, only those of the connection parts 632 and 633 which are located at vehicle-longitudinal-directionally both ends are denoted by the reference signs.

At the outer circumference of the part surrounding the openings 745, the flange parts 741 and 742 are formed by which the circumferential edge of the opening 103 formed in the bottom portion of the battery case 20 is clamped from the inside and the outside of the bottom chamber 20B. The part 743 located between the flange parts 741 and 742 has dimensions so set as to conform to the inner edge of the opening 103.

Now, the positional relationship between the male-side terminals 63 and the female-side terminals 73 corresponding to the positional relationship between the battery pack 19 and the terminal base 29 will be described below. FIGS. 27A to 27E are sectional views showing the positional relationship between the male-side terminal 63 and the female-side terminal 73, as viewed from the rear side of the vehicle body. First, in FIG. 27A, the insulator block 74 with the female-side terminal

- 28 -

73 accommodated therein is brought closer to the male-side terminal 63 from a right upper side of the vehicle body.

In FIG. 27B, the tip of the male-side terminal 63 is in such a position that it is partly inserted in the insulator block 74. Since the opening 745 of the insulator block 74 is formed with a taper, a large clearance CL1 is maintained between the corner 63f formed by obliquely cutting the tip of the male-side terminal 63 and the insulator block 74.

In FIG. 27C, the tip of the male-side terminal 63 is in contact with an end portion (an end portion on the side of the opening 745) of the female-side terminal 73 inside the insulator block 74. In this position, the corner 63f of the male-side terminal 63 and the taper surface of the opening 745 of the insulator block 74 are roughly parallel to each other.

A tip portion of the male-side terminal 63 is smashed so that plate thickness decreases toward the tipmost portion. A ridgeline 63h exists at the boundary between the portion of the smashed shape and the portion where the plate thickness is maintained.

In FIG. 27D, the ridgeline 63h at the tip portion of the male-side terminal 63 and the end portion 731 of the female-side terminal 73 are roughly parallel to each other. In this instance, the clearance CL2 between the corner 63f of the male-side terminal 63 and the insulator block 74 is smaller than the clearance CL1. However, the male-side terminal 63 and the insulator block 74 are not in contact with each other.

In FIG. 27E, there is shown a connected state where the battery pack 19 is mounted on the terminal base 29 in the position as shown in FIG. 18D. In this state, the male-side terminal 63 has entered into the female-side terminal 73, and the connection has been completed. In this state, on one side (the vehicle body left side) of the male-side terminal 63, clearances CL3 and CL4 are maintained between the male-side terminal 63 and the insulator block 74. On the other side (the vehicle body right side) of the male-side terminal 63, also, clearances CL5 and CL6 are maintained, which are smaller than the clearances CL3 and CL4, though. FIG. 28 shows an enlarged view of an essential part of FIG. 27E.

- 29 -

The handle 34 formed at an upper portion of the battery case 20 is provided at a position deviated toward the right side of the battery pack 19. Therefore, it suffices for the middle chamber 20M as the battery cell accommodating part to be located just under the main frame 3 of the motorcycle 1. This ensures that the handle 34
 5 itself on the right side of the main frame 3 can be raised to such an upper position as to overlap with the main frame 3 in side view of the vehicle body. With the handle 34 thus located at an upper position, the middle chamber 20M can be enlarged, and more battery cells can be accommodated therein.

10 Besides, while the main frame 3 of the motorcycle 1 is a monocoque-type simple one, this is not restrictive. An under frame extending downward from the head pipe 2 to be joined at its rear end to lower end portions of the pivot plates 4 may be provided.

15 FIG. 29 is a right side view of an essential part of the motorcycle 1 provided with an under frame. In FIG. 29, a skid plate 106 may be provided forwardly of (on the vehicle body front side of) the under frame 105. It suffices for the skid plate 106 to cover a front lower side of the battery pack 19, at least. However, it is preferable to provide the skid plate 106 so as to range from the front side of the under frame
 20 105 to the motor case 23. This is for protecting the battery pack 19 and the motor case 23 from small stones, sand, mud or water, etc. flying from the front and lower sides of the motorcycle 1. Incidentally, where the under frame 105 is provided, as shown in FIG. 29, the PDU 33 can be mounted not to the bracket 31 but to the under frame 105.

25 Besides, in FIG. 29, a lock device support stay 30 for fixing the lock device 32 can be extended toward the vehicle body rear side to form a part 30a, and an upper portion of the battery pack cover 28 can be connected by the thus extended part 30a. This ensures that the battery cover 28 can be supported at its lower portion by the
 30 battery pack holding stay 27 extended from the motor case 23, and at its upper portion by the lock device support stay 30.

The scope of the claims should not be limited by the preferred embodiments
 35 set forth in the examples, but should be given the broadest interpretation consistent with the description as a whole.

WH-13925CA
SN 2,798,658

- 30 -

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

1. A power supply device for an electric vehicle, which comprises a battery case for
5 accommodating battery cells for supplying electric power to an electric motor of an electric
vehicle and which can be mounted to and detached from the electric vehicle,
wherein the power supply device further comprises
a battery case terminal downwardly connectible with an upwardly accessible
vehicle body terminal accommodated in a terminal base provided on a vehicle body, and
10 a battery case mounting part provided in a base portion of said battery case for
downward engagement with a vehicle body mounting part formed at an upper surface of the
terminal base;
the vehicle body mounting part is disposed at a position offset to one side of a center
position with respect to the width of the vehicle; and
15 the battery case mounting part is disposed at an offset position in the width of the
battery case and the battery case mounting part cooperates and fits with the vehicle body
mounting part when the battery case terminal is downwardly connected with said vehicle
body terminal.
- 20 2. The power supply device for electric vehicle according to claim 1, wherein the
vehicle body mounting part is an engagement projection, the battery case mounting part is an
engagement recess which fits to the engagement projection, and, for mutual positioning, the
engagement projection and the engagement recess are provided with wall parts parallel to a
direction in which the battery case is mounted to and detached from the electric vehicle.
- 25 3. The power supply device for electric vehicle according to claim 2,
wherein the terminal base is formed with a shelf protruding horizontally from a foot
portion of the engagement projection; and
the positions and shapes of the engagement projection, the engagement recess, and
30 the shelf are so set that a lower open end portion of the engagement recess makes contact with
an upper surface of the during installation of the battery case with the vehicle body terminal
such that a peak portion of the engagement projection makes contact with an inner surface of
an uppermost portion of a wall part forming the engagement recess.

35

WH-13925CA
SN 2,798,658

- 31 -

4. The power supply device for electric vehicle according to claim 3,
wherein the battery case is roughly rectangular parallelepiped in general shape, a
lower surface of the roughly rectangular parallelepiped being formed with an angled surface
extending obliquely upward from the lower open end portion of the engagement recess; and
5 the angled surface is so inclined that the angled surface is situated to engage the shelf
during installation of the battery case.
5. The power supply device for electric vehicle according to claim 3,
wherein the vehicle body mounting part is provided at each of two positions of an
10 upper surface of the terminal base;
the terminal base is provided with a second engagement part disposed between the
vehicle body mounting parts; and said engagement parts protruding horizontally from an
upper portion of the engagement projection as the vehicle body engagement part.
- 15 6. The power supply device for electric vehicle according to claim 5, wherein the
engagement recess of the battery case includes a wall part coinciding roughly with a locus of
movement of the upper portion of the engagement projection during installation of the battery
case to said battery case terminal.
- 20 7. The power supply device for electric vehicle according to any of claims 1 to 6,
wherein a lower surface of the battery case is formed with a fitting hole in which a projected
part provided on an upper surface of the terminal base is fitted during installation of said
battery case in said terminal base.
- 25 8. The power supply device for electric vehicle according to any of claims 1 to 7,
wherein the terminal base includes an attached battery cover, said battery cover
covering opposed sides, a back face and bottom face of said battery case when said battery
case is received in said terminal base.

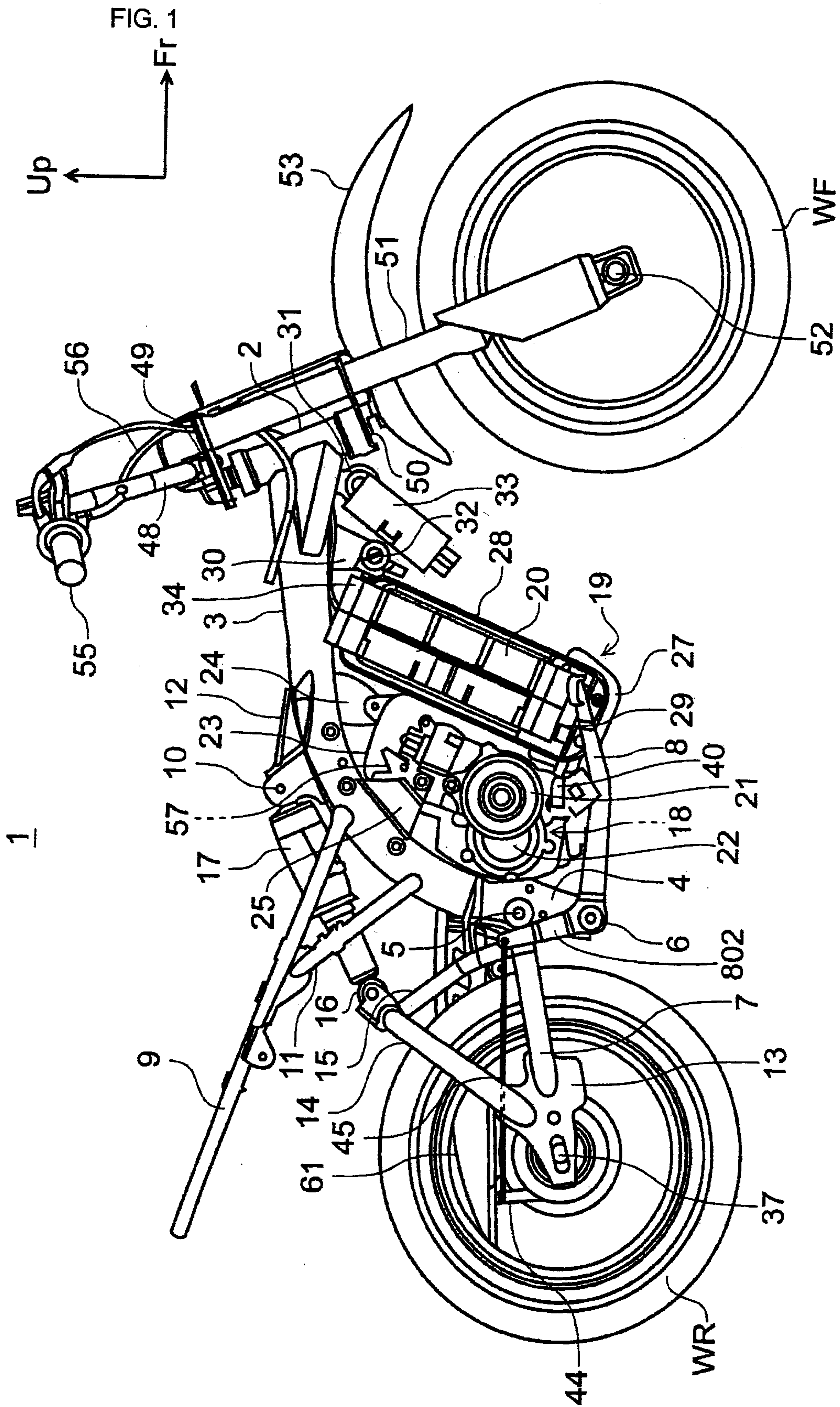


FIG. 2

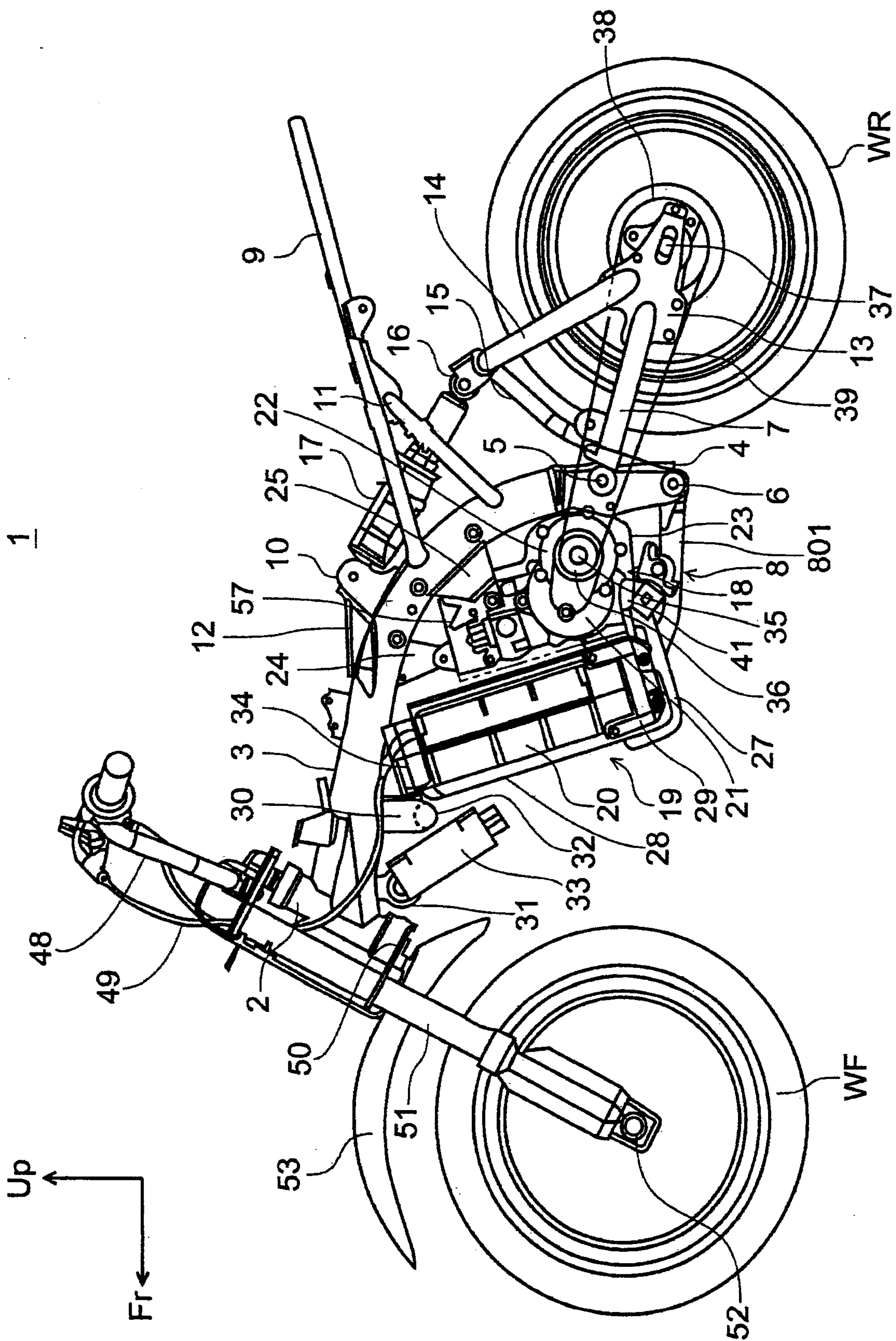


FIG. 3

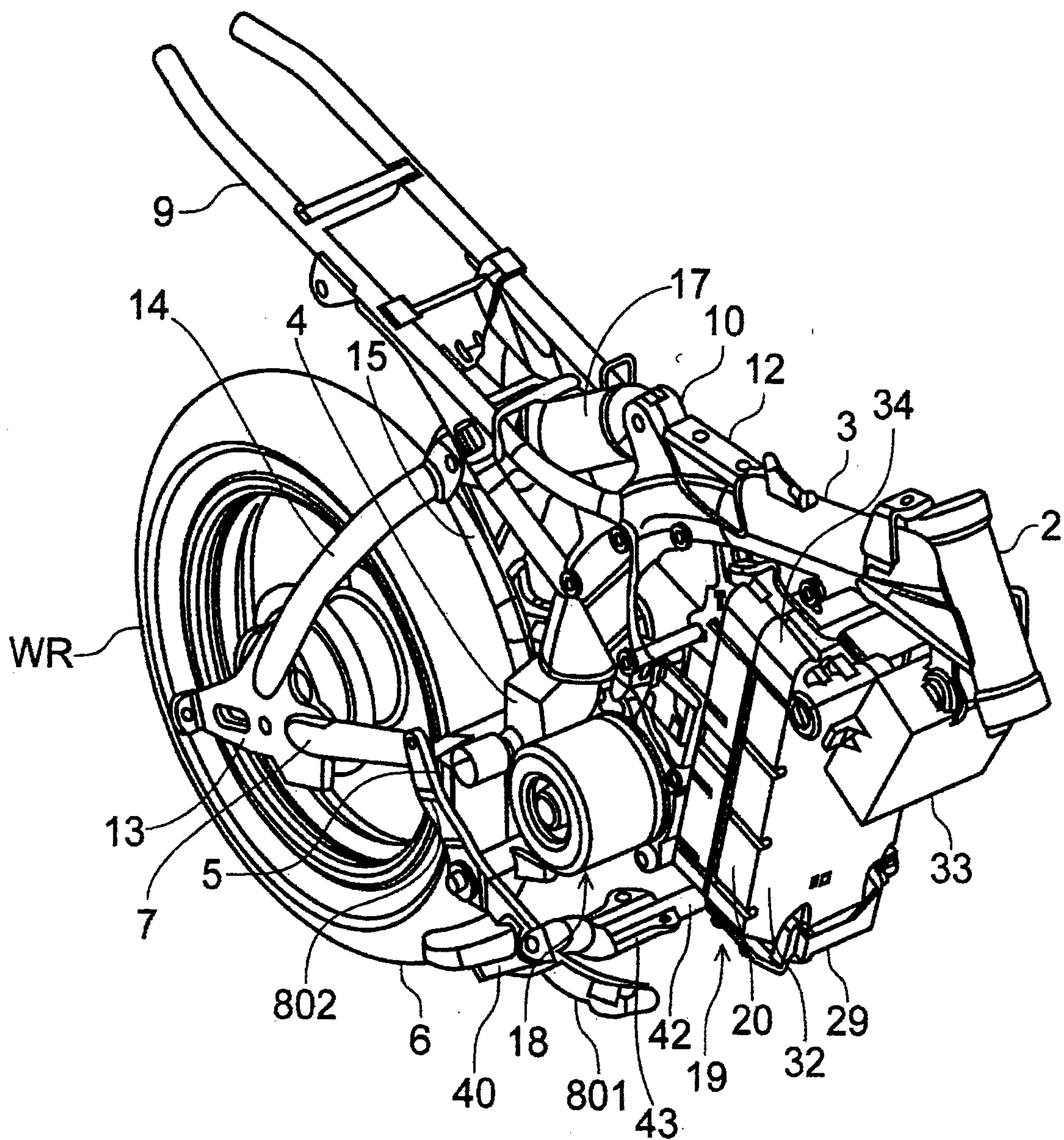


FIG. 4

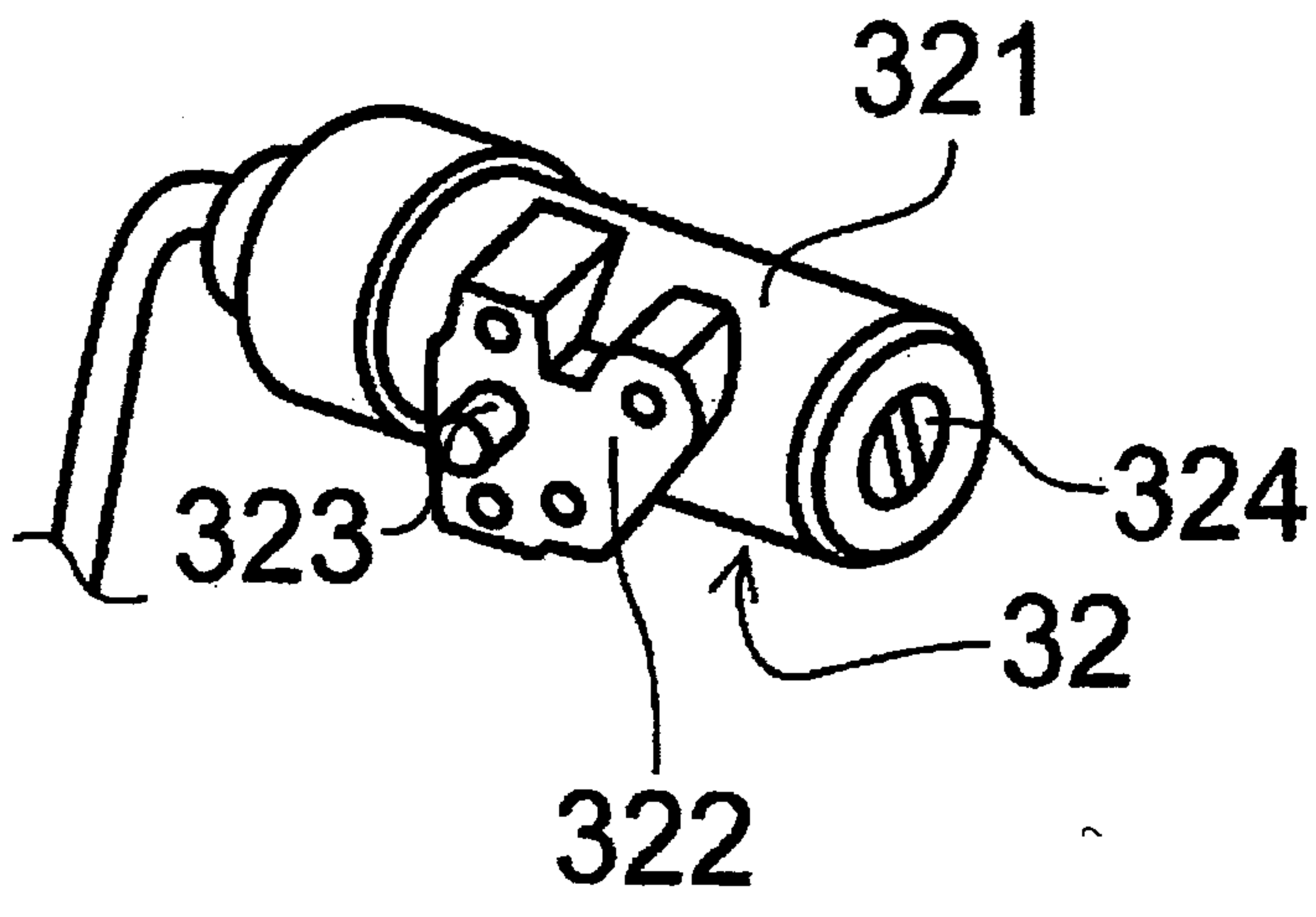


FIG. 5

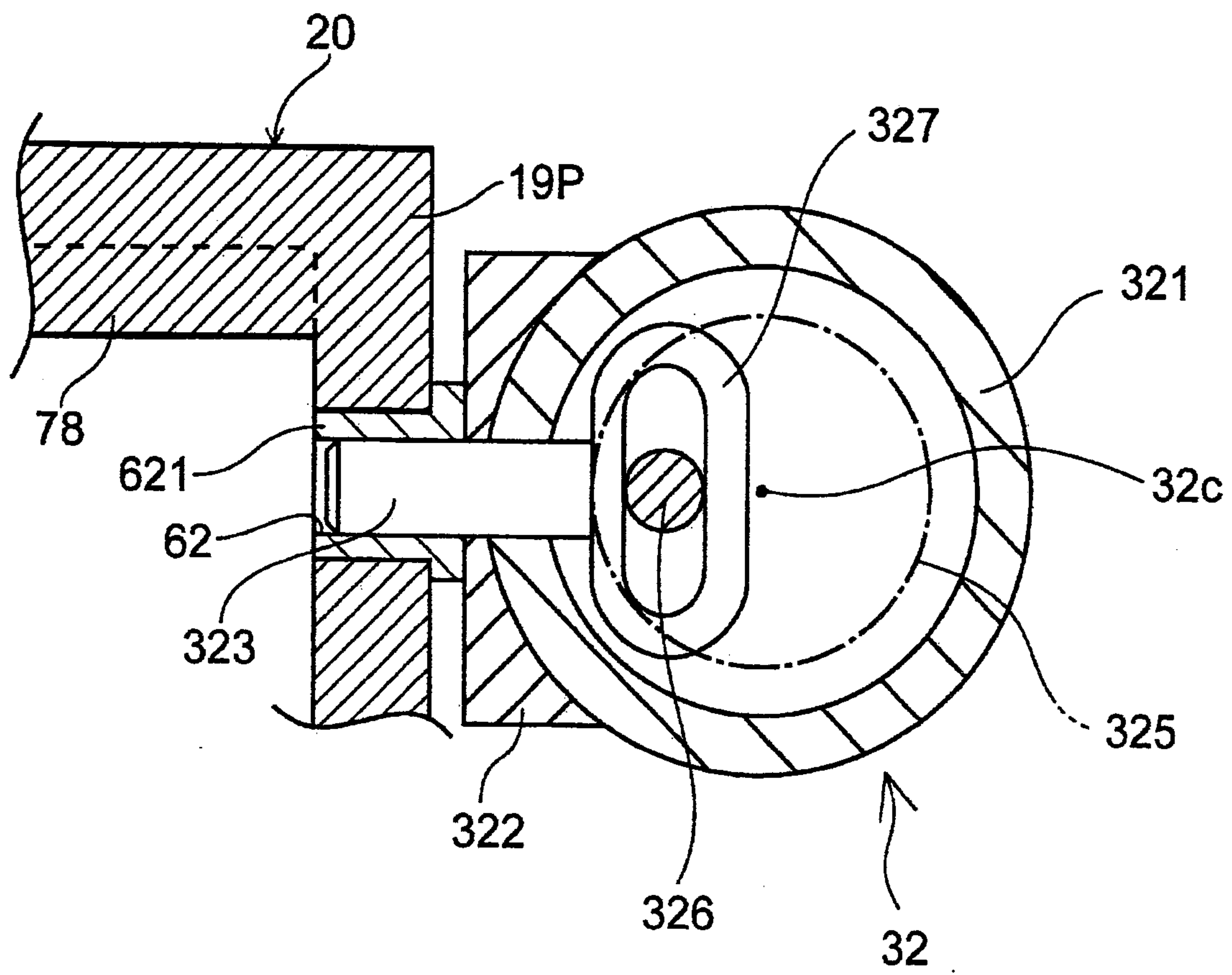


FIG. 6

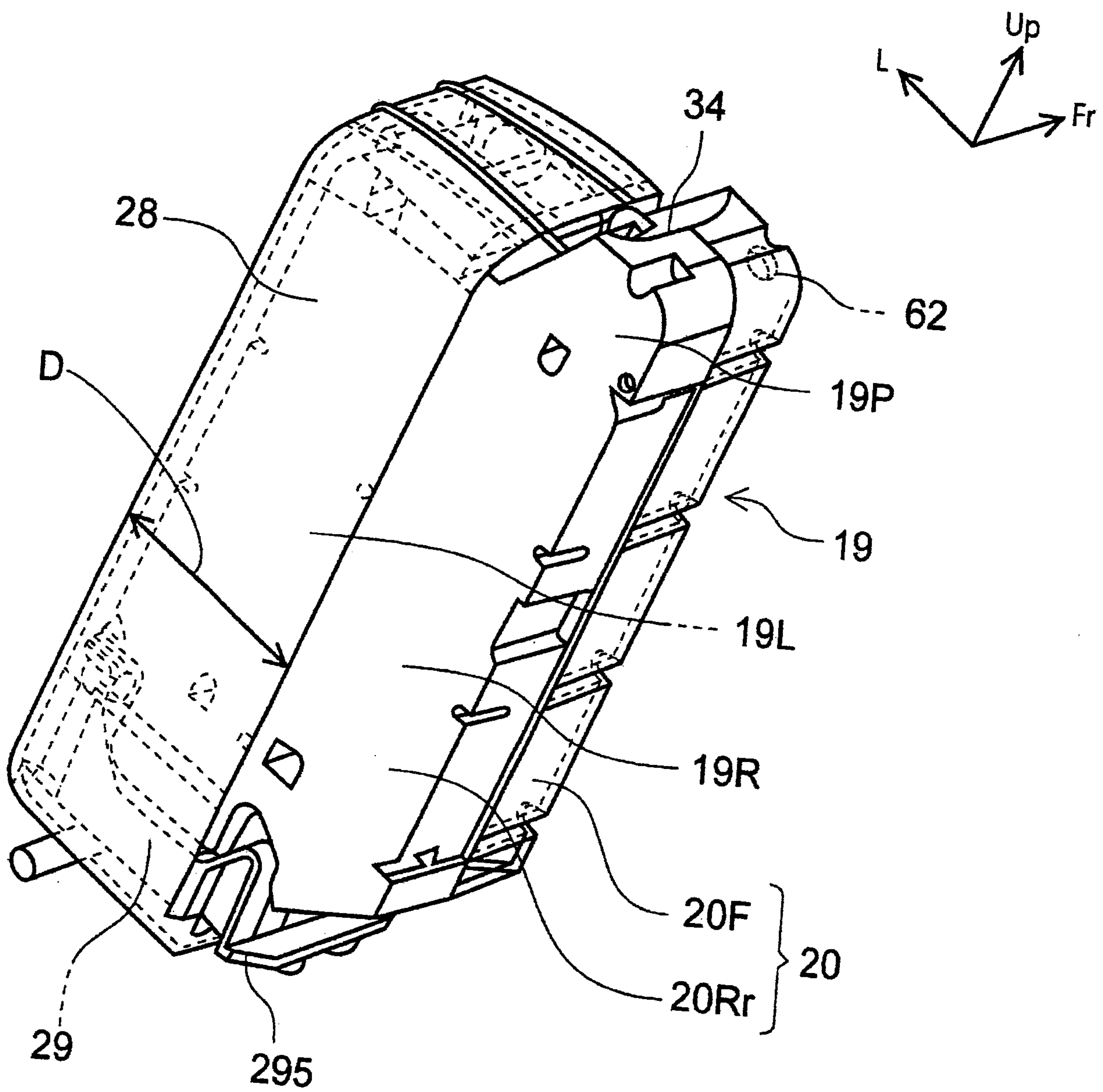


FIG. 7

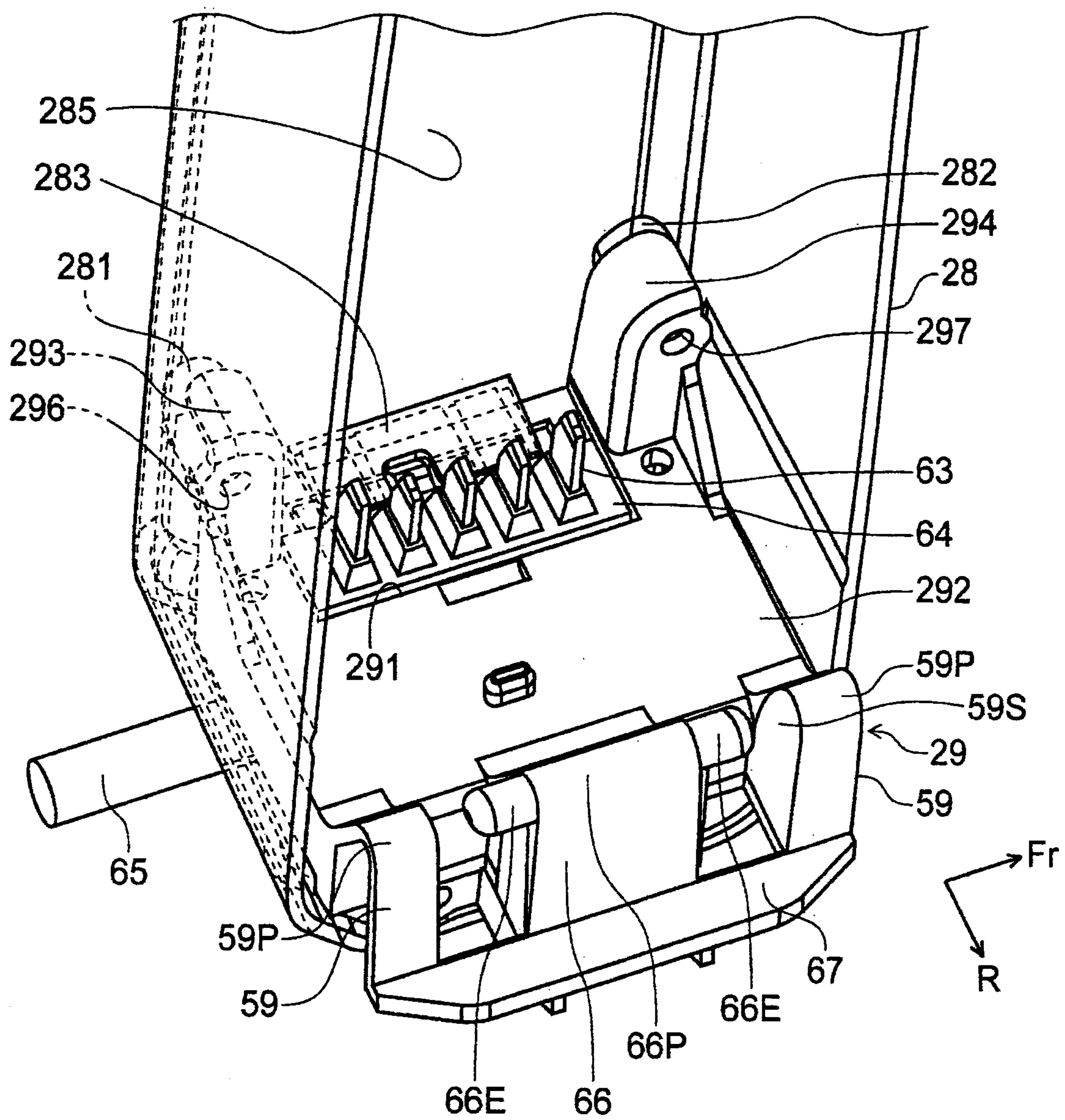


FIG. 8

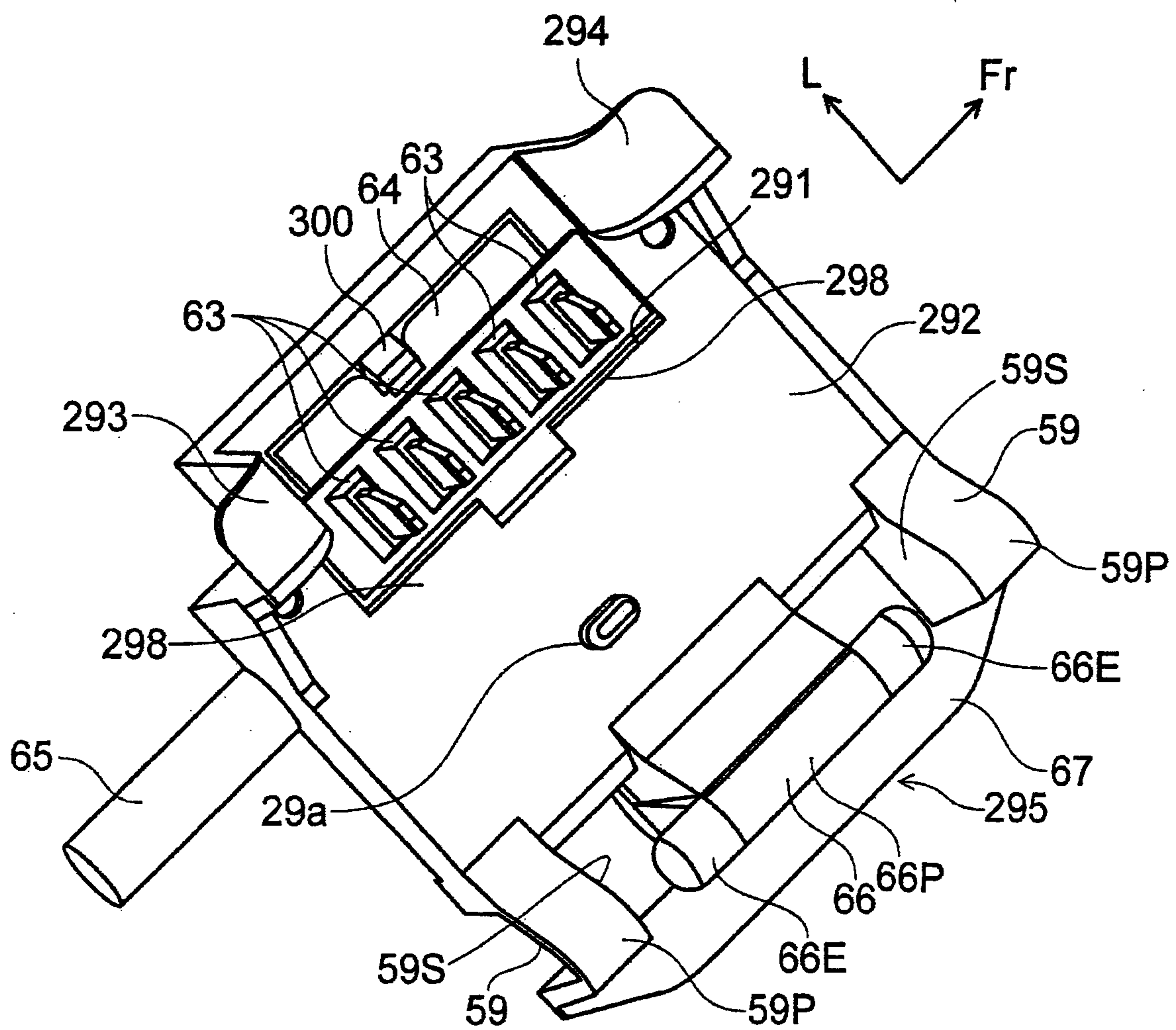


FIG. 9

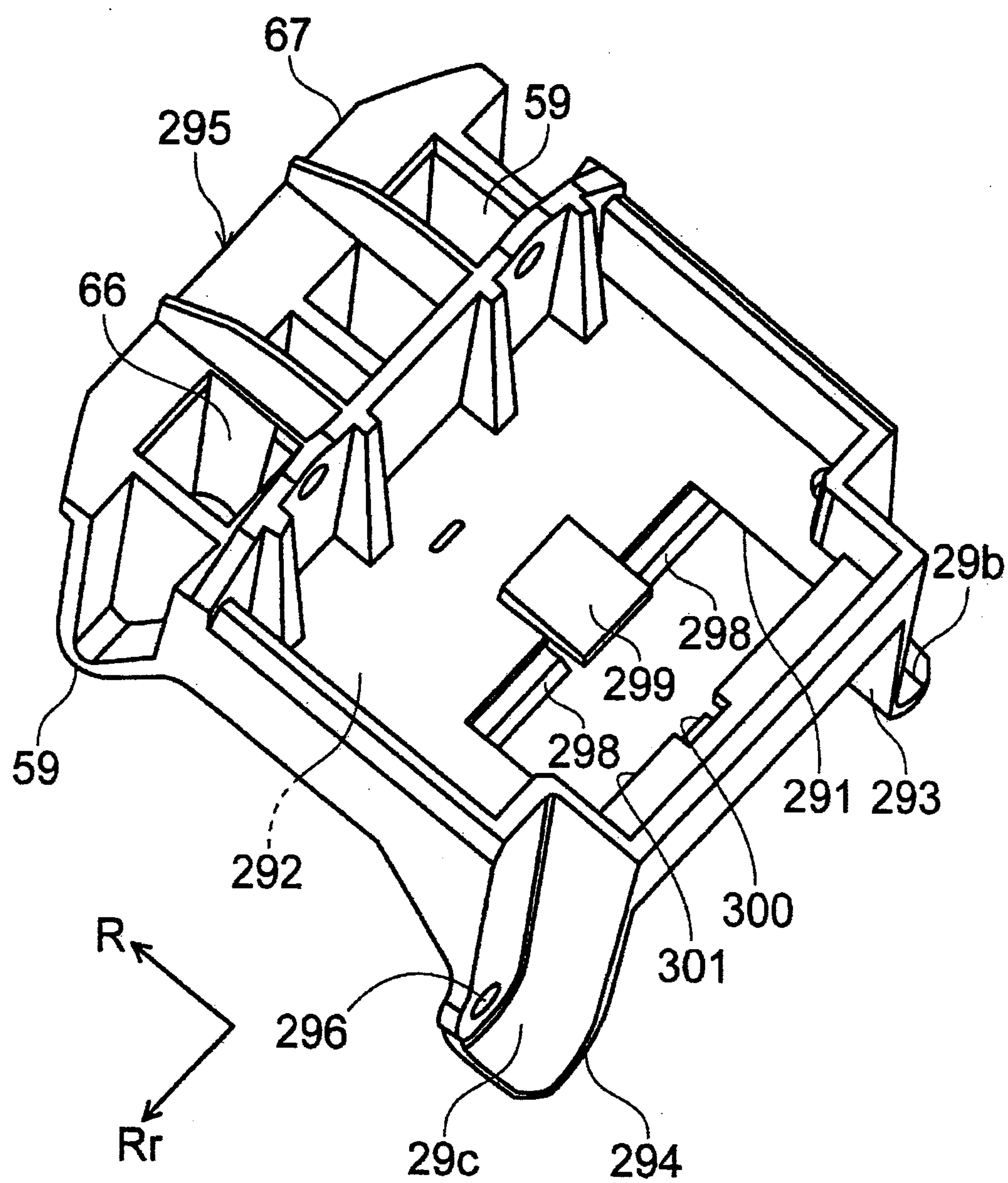


FIG. 10

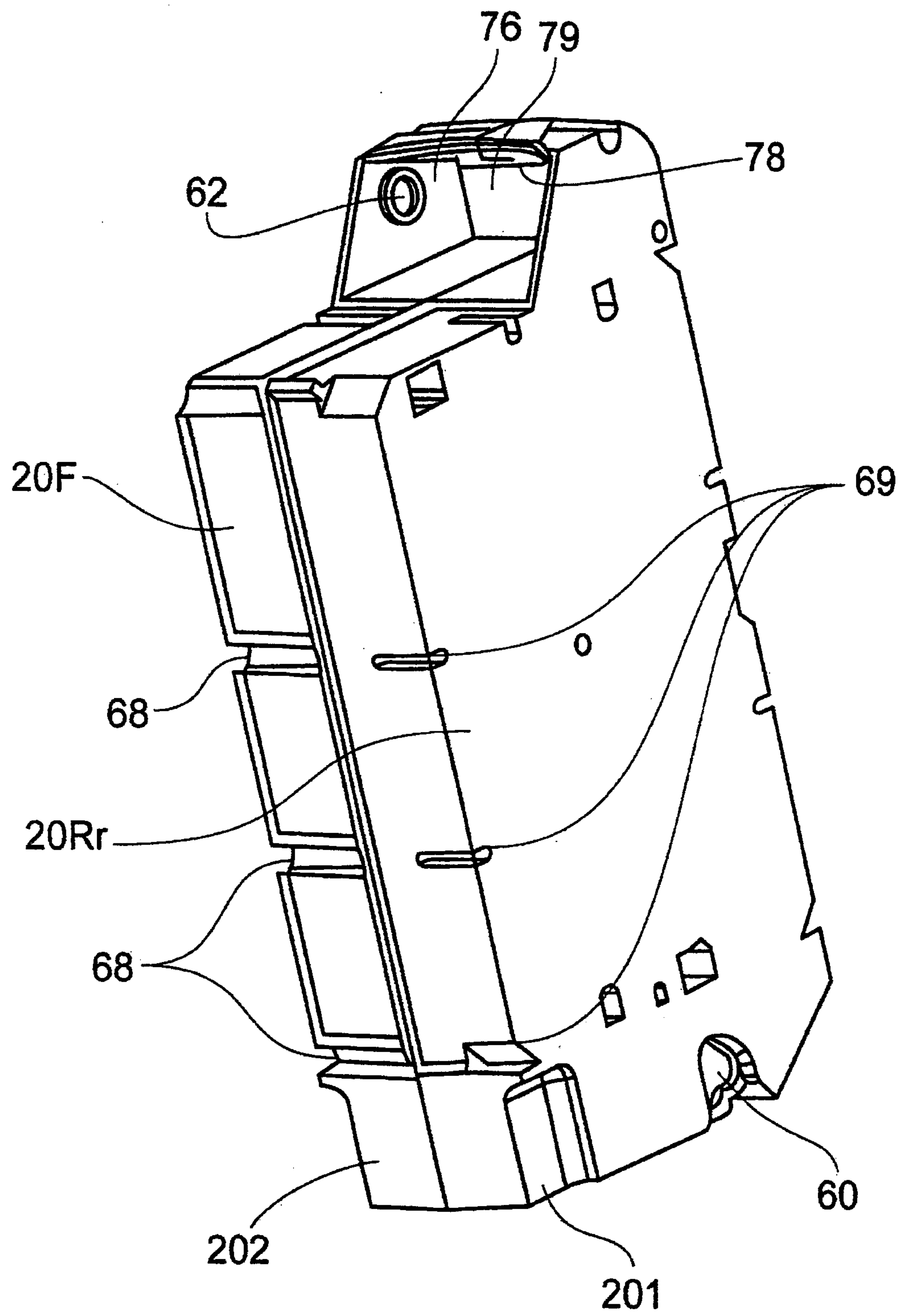


FIG. 11

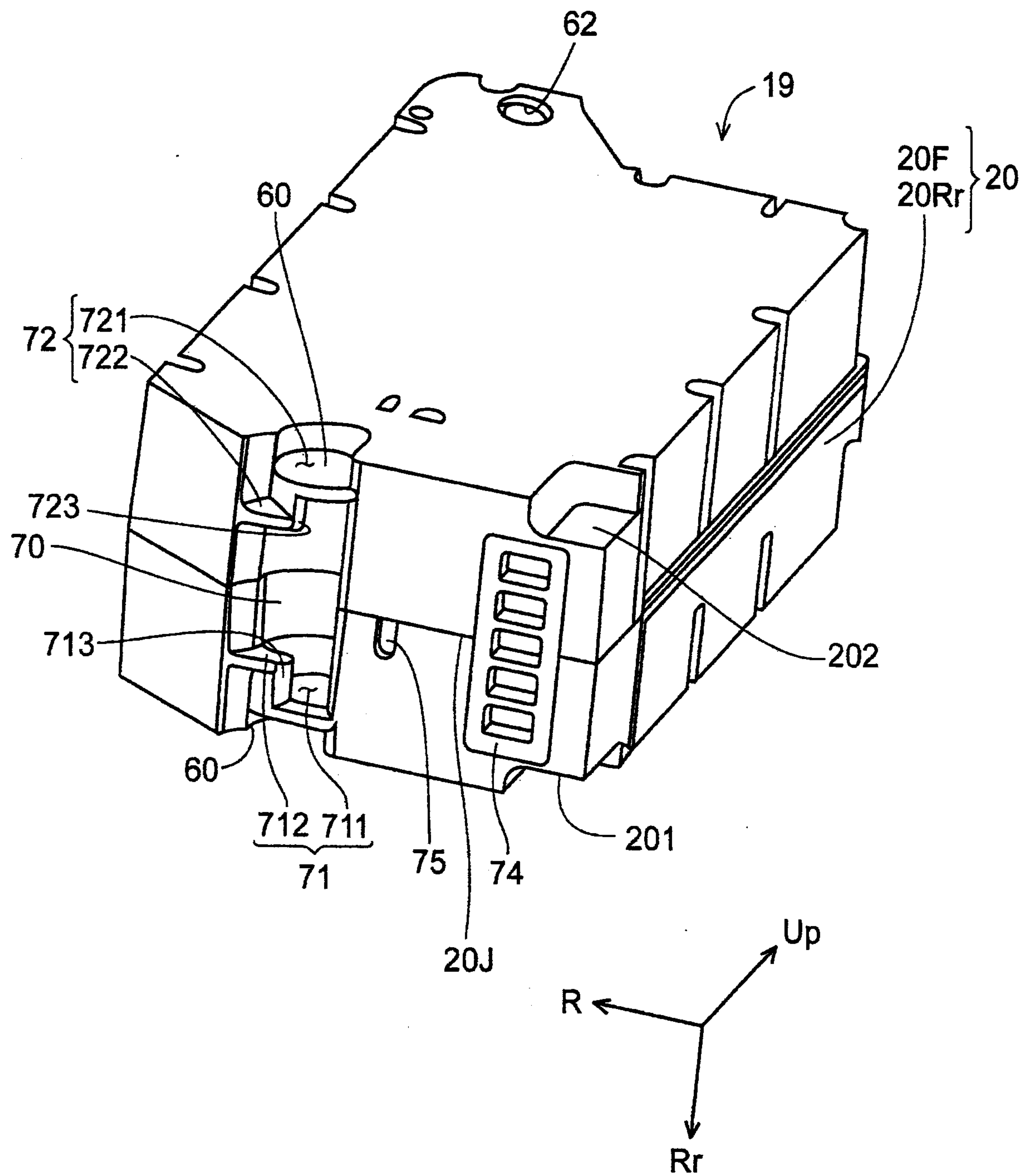


FIG. 12

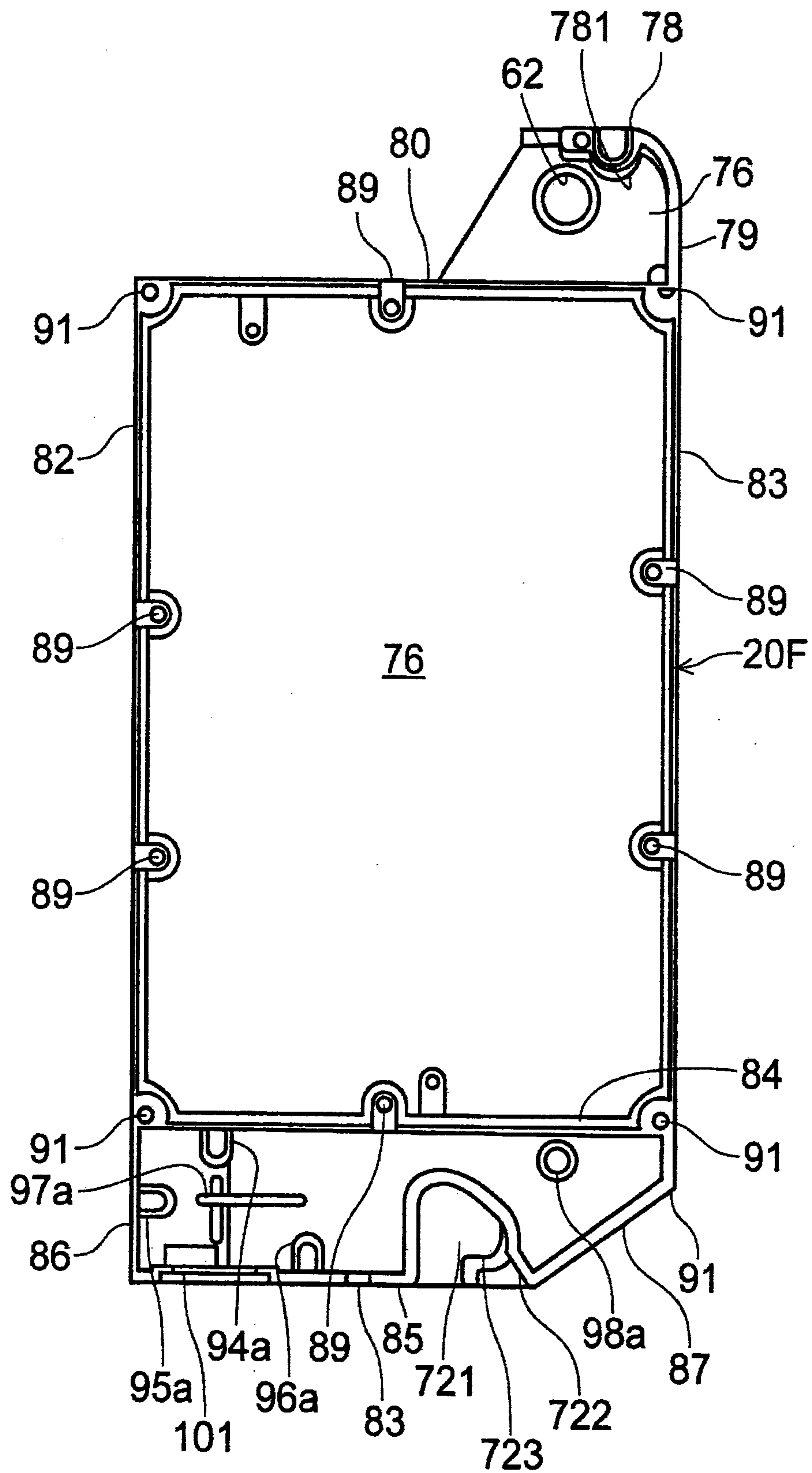


FIG. 13

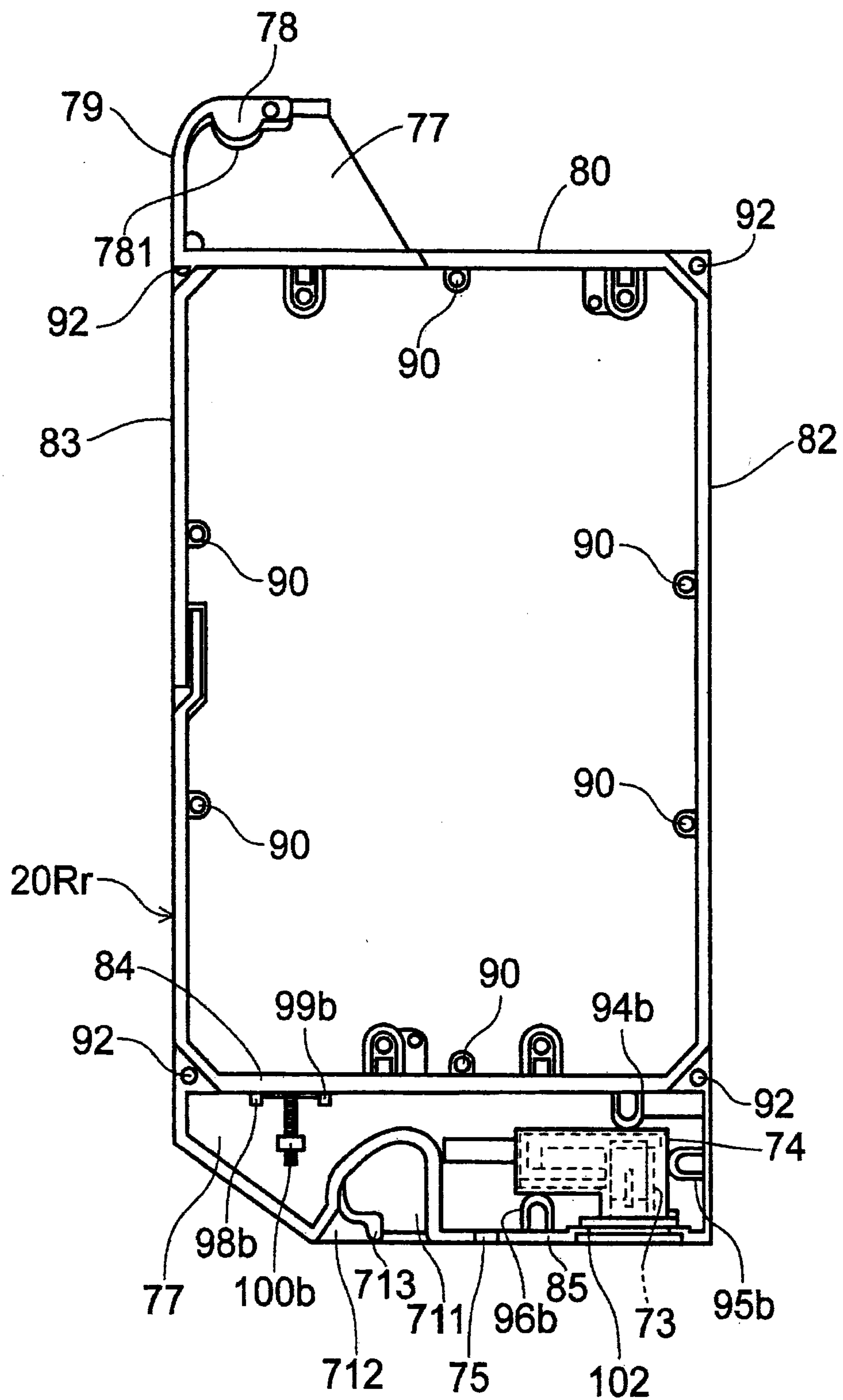


FIG. 14

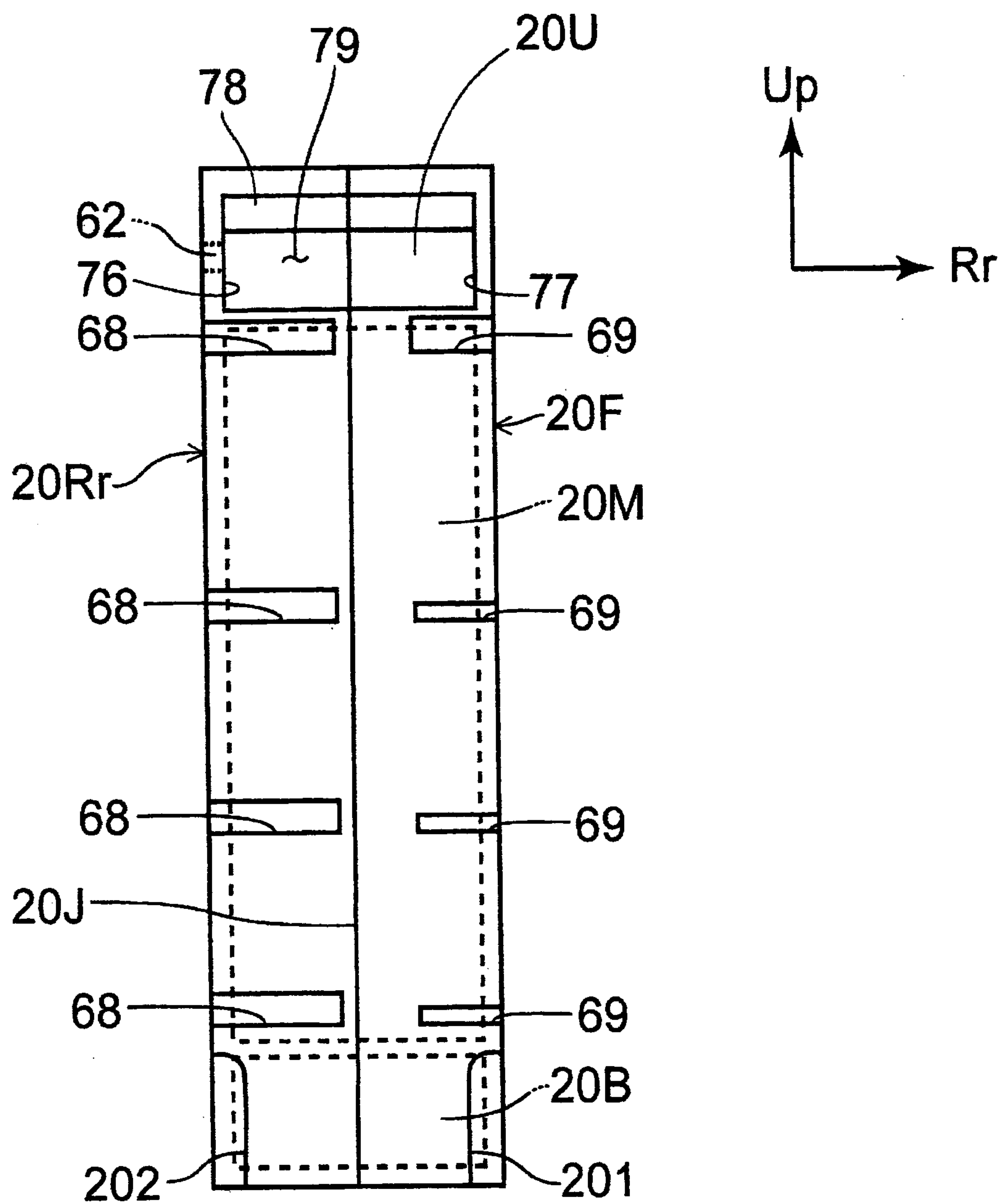


FIG. 15

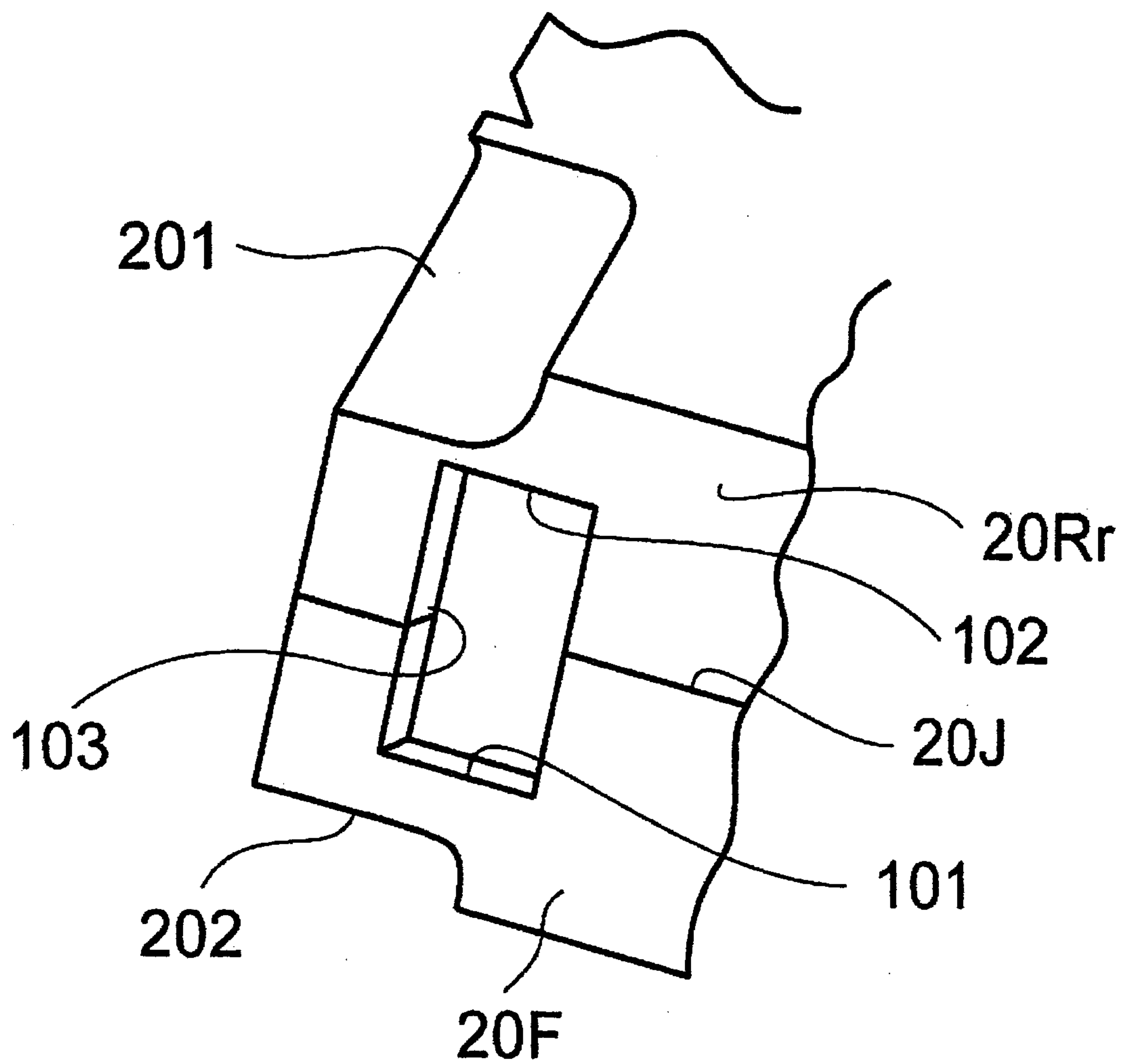


FIG. 16

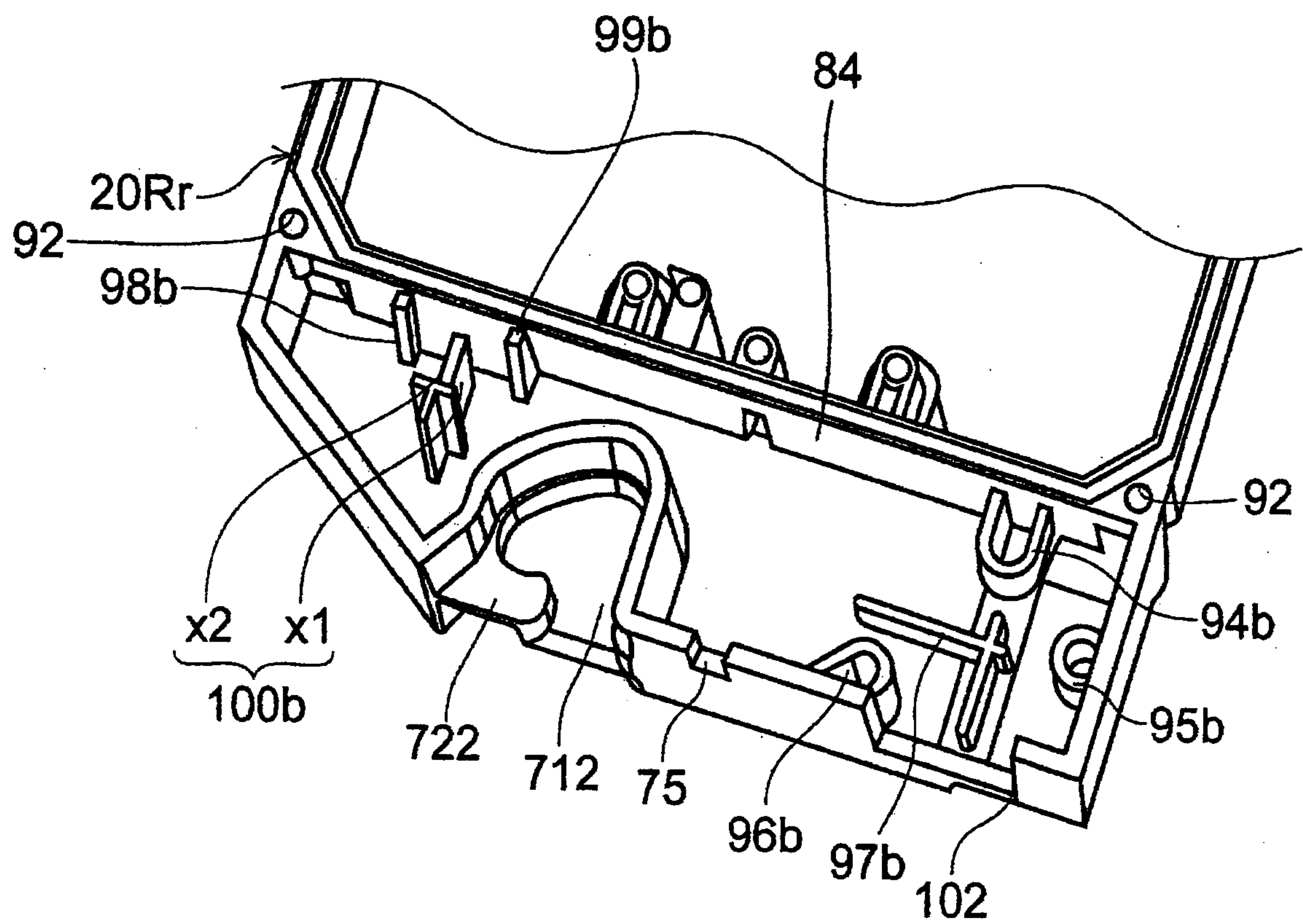


FIG. 17

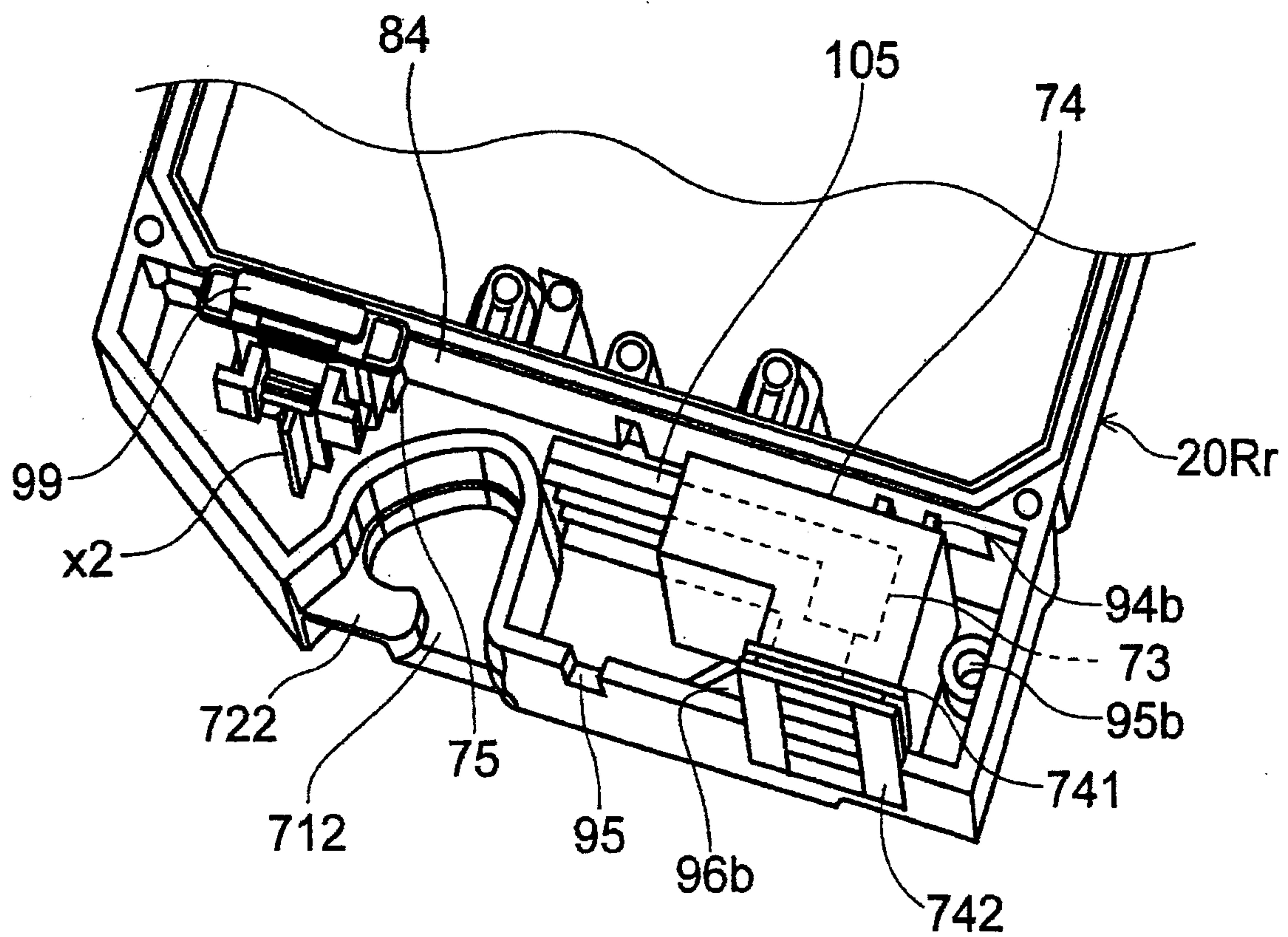


FIG. 18B

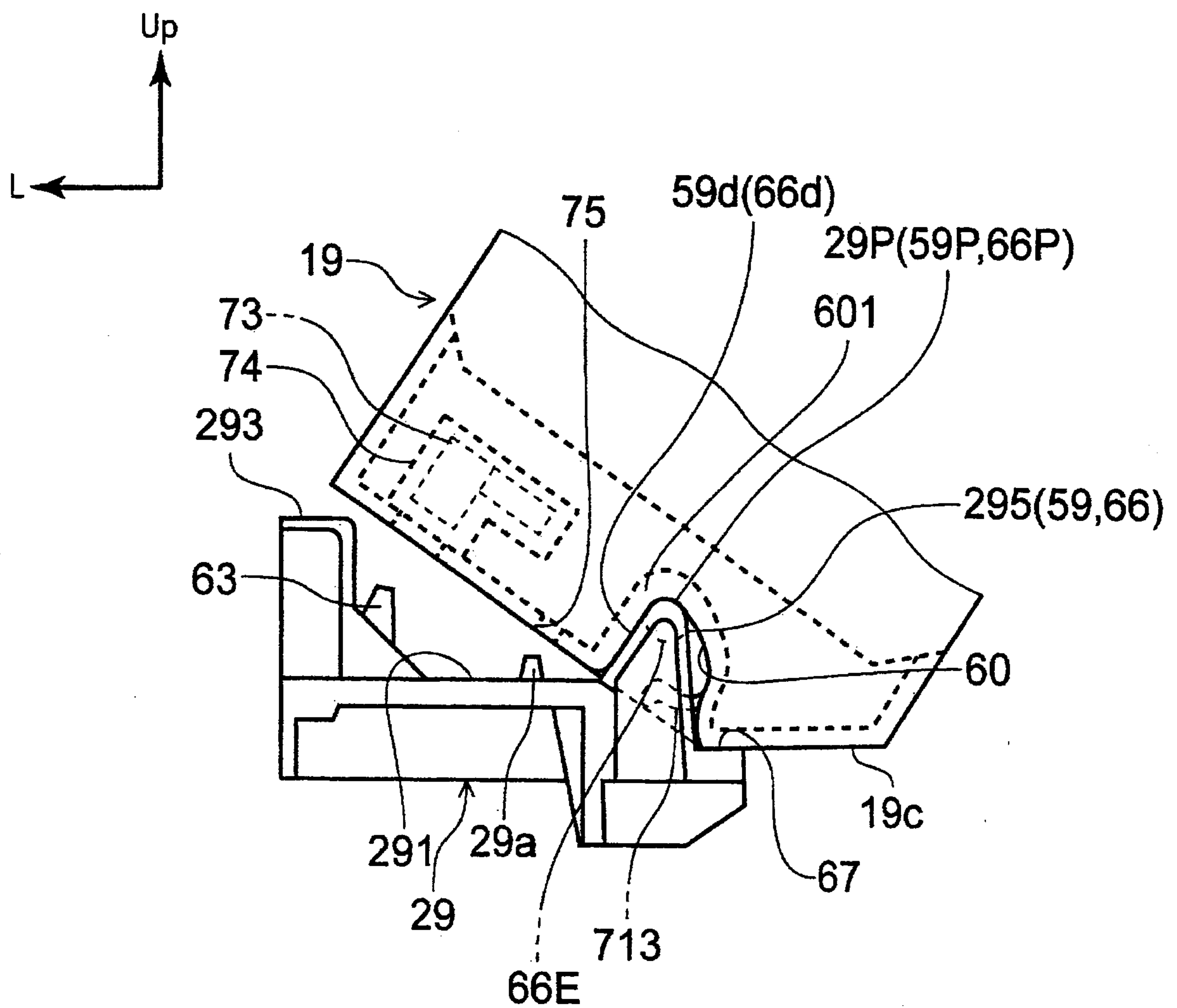


FIG. 18C

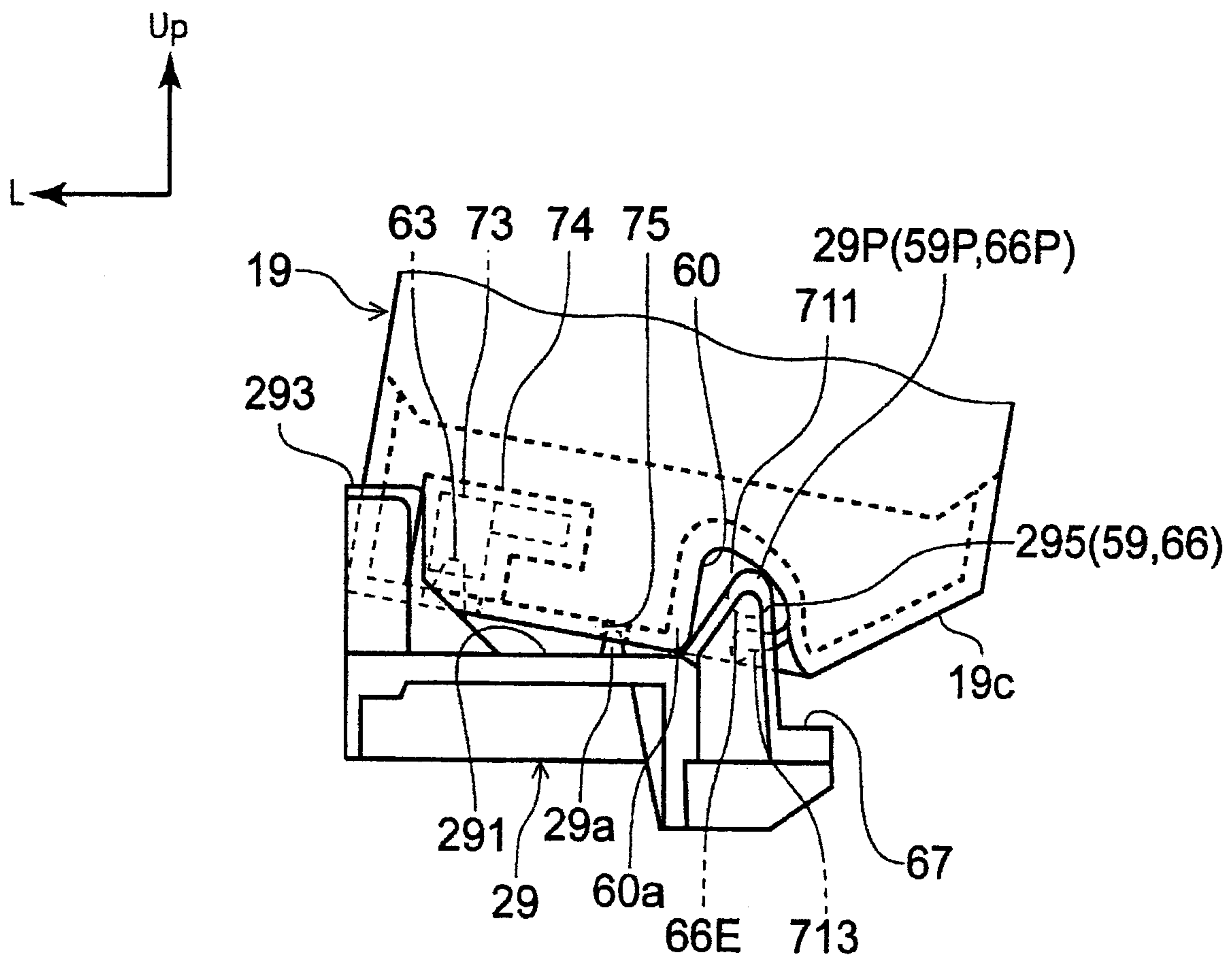


FIG. 18D

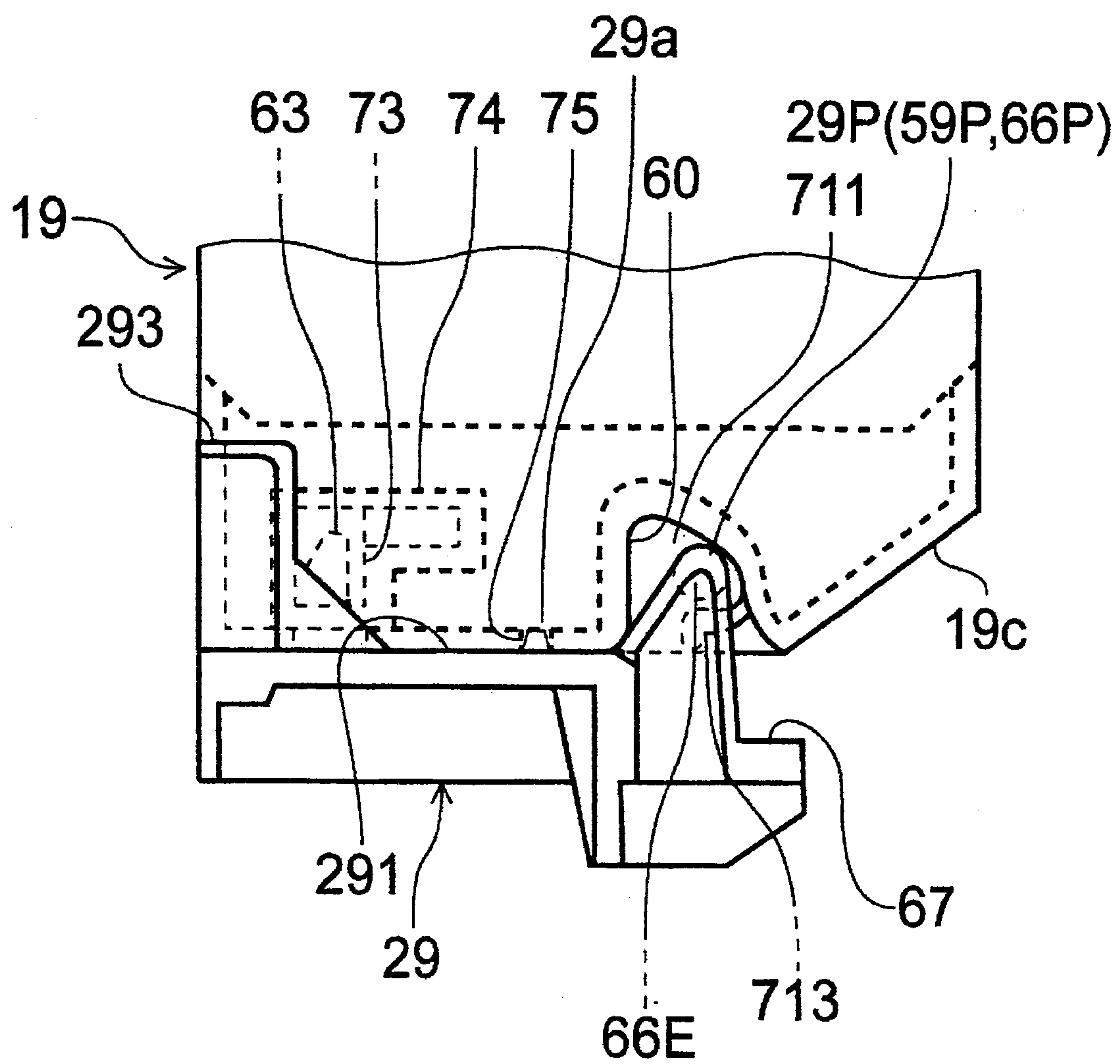


FIG. 19A

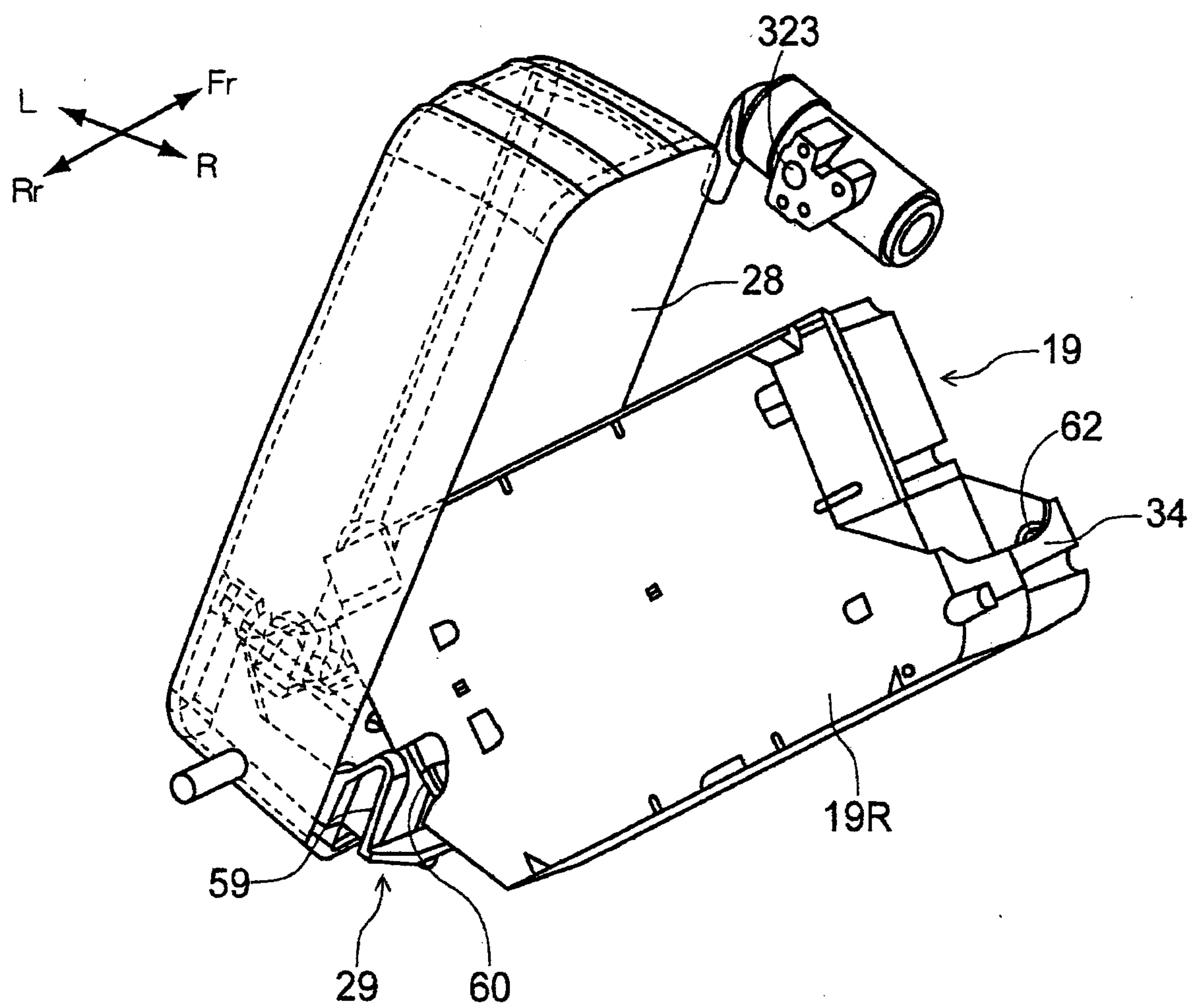


FIG. 19B

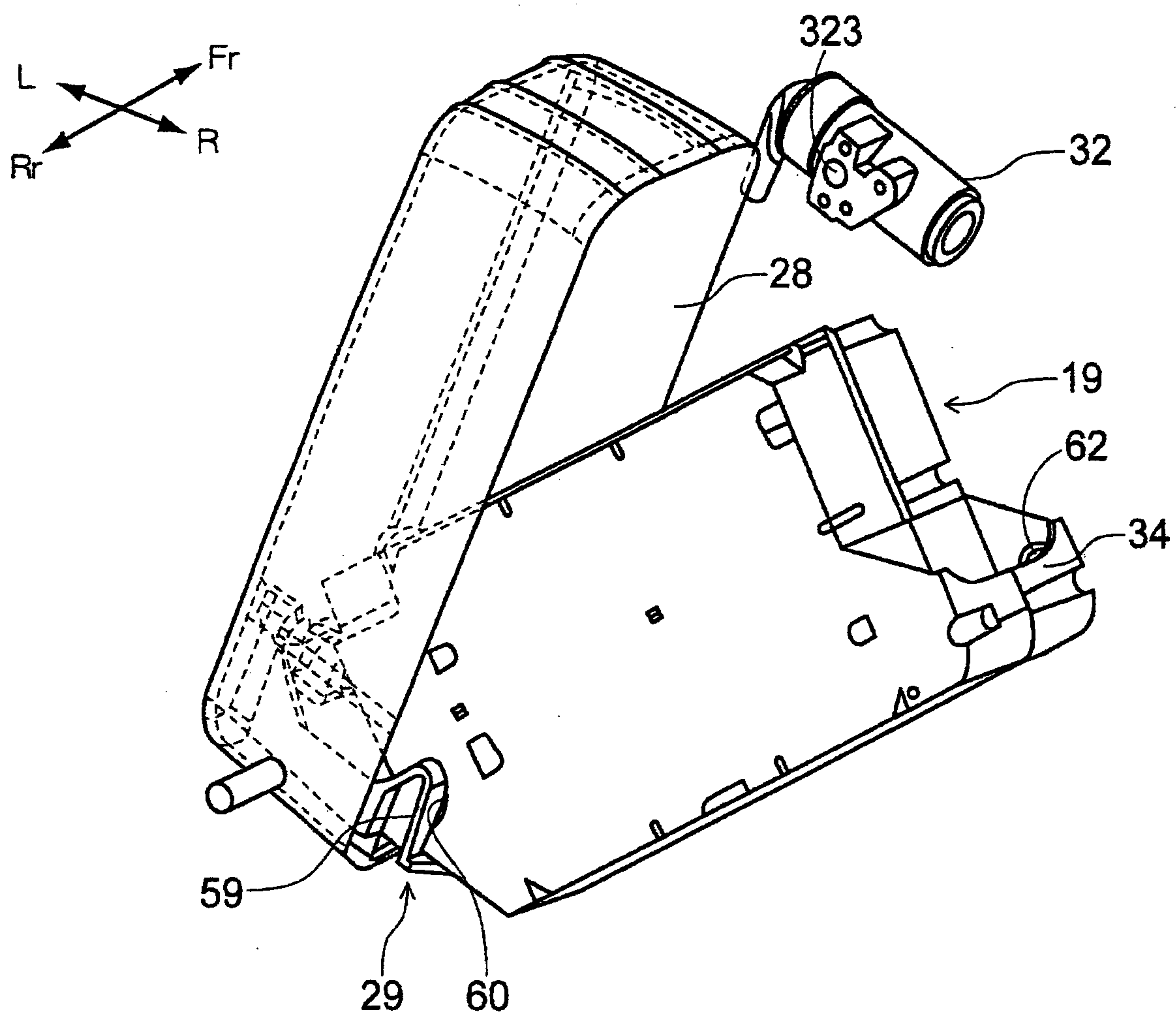


FIG. 19C

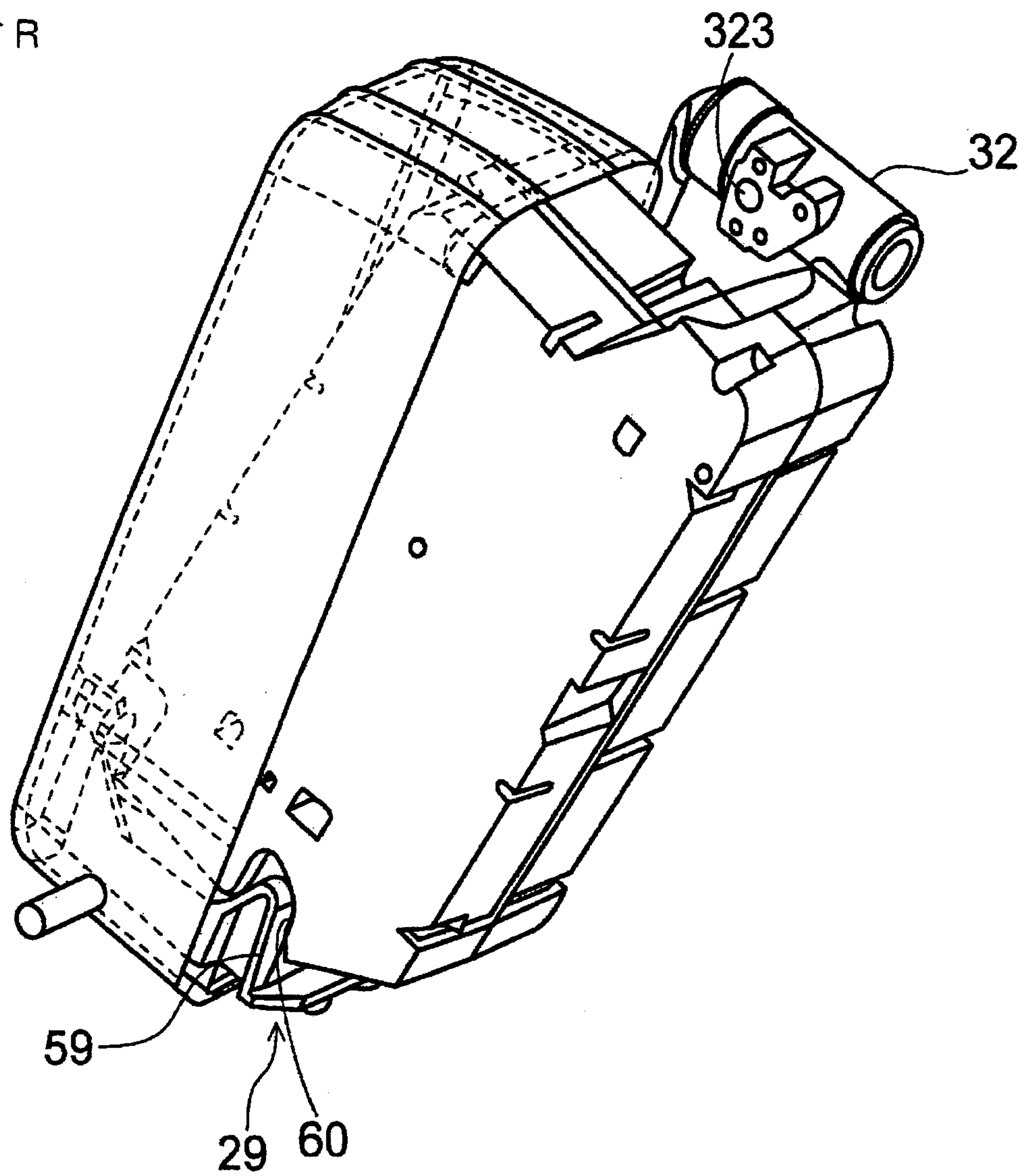
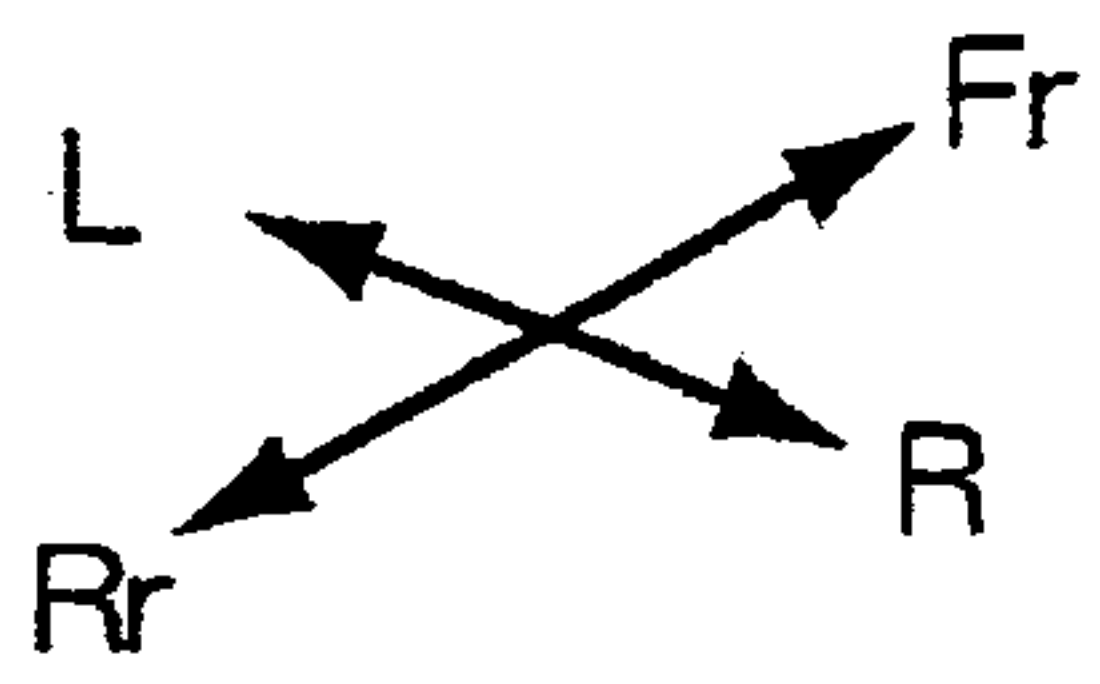


FIG. 19D

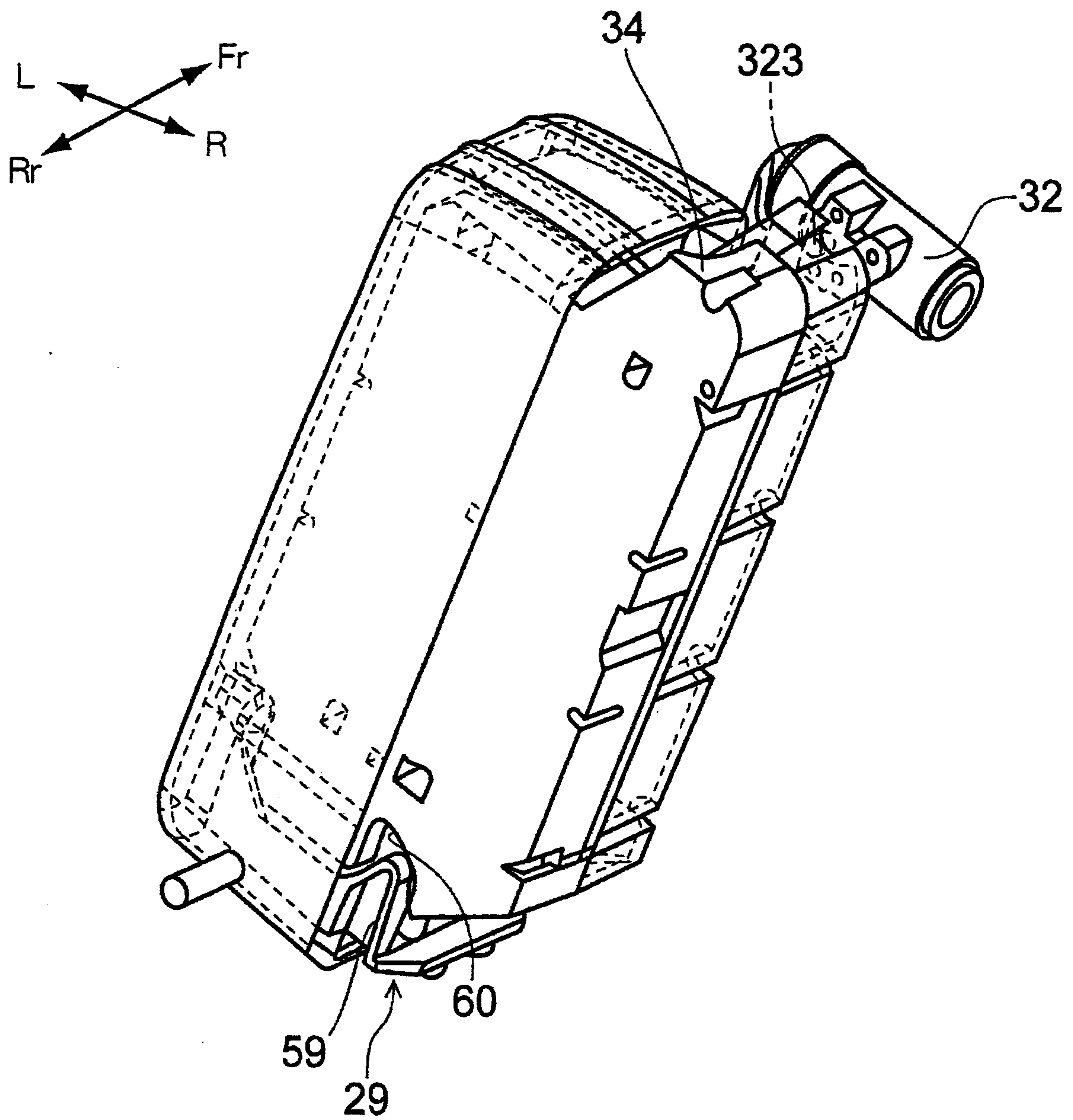


FIG. 20

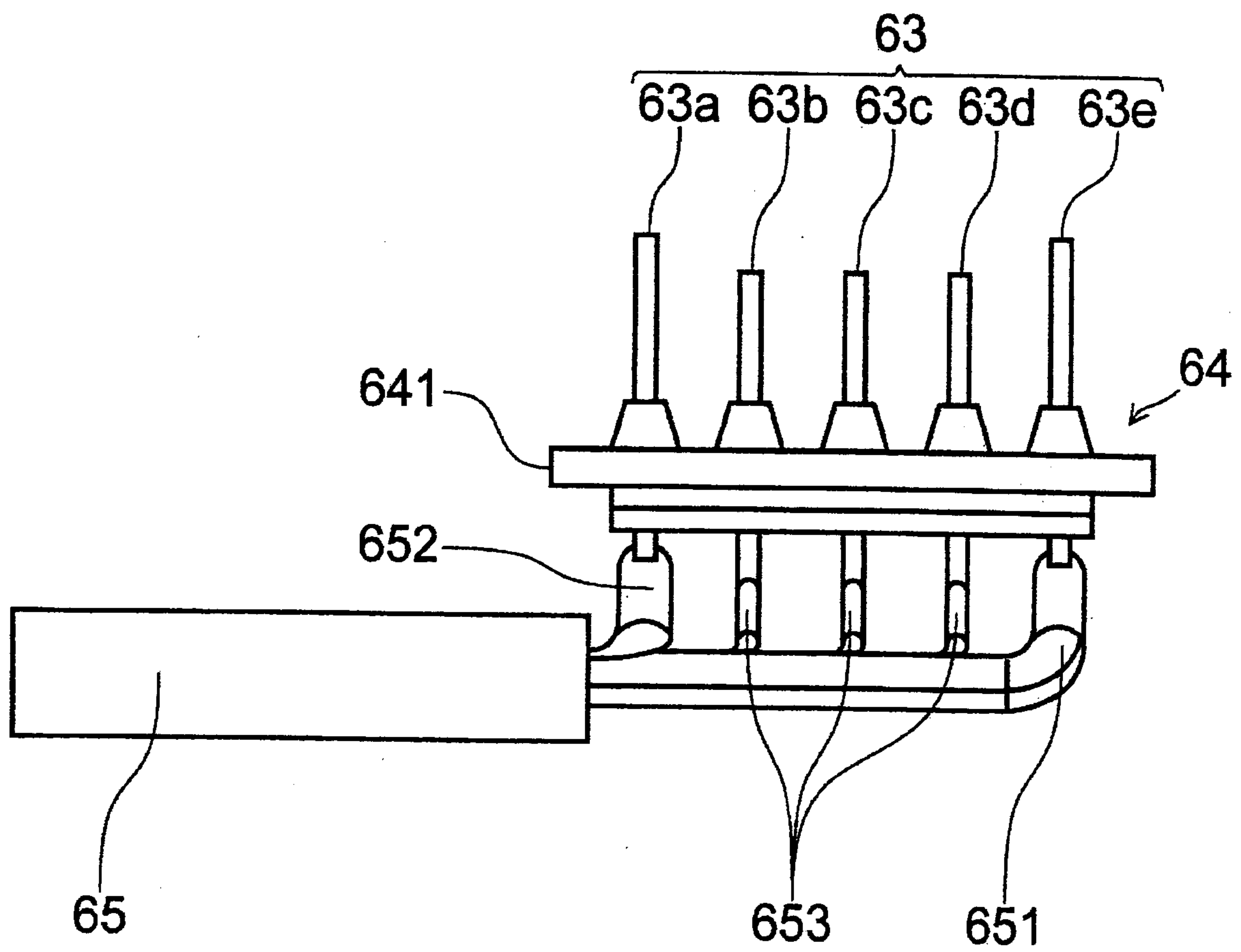


FIG. 21

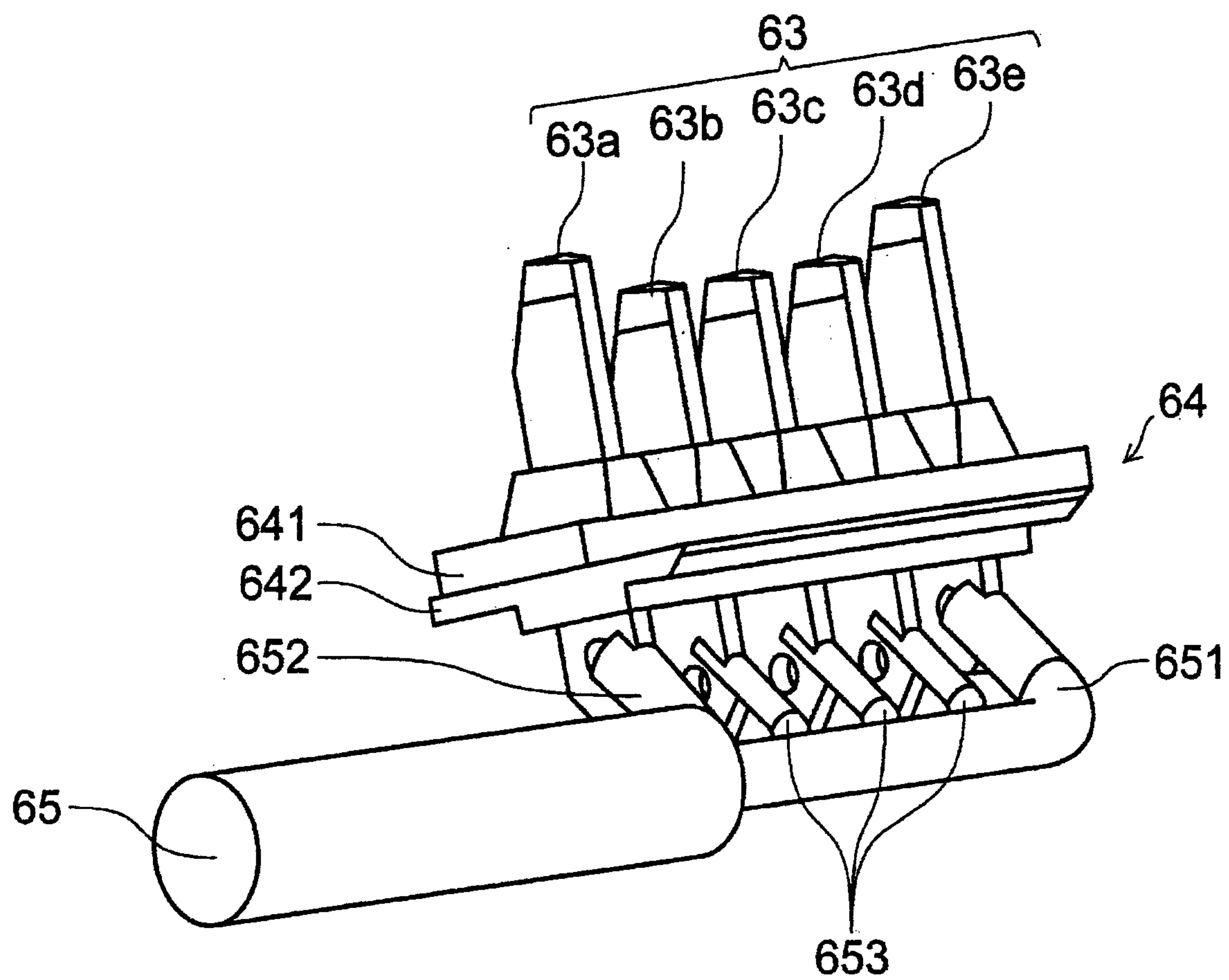


FIG. 22

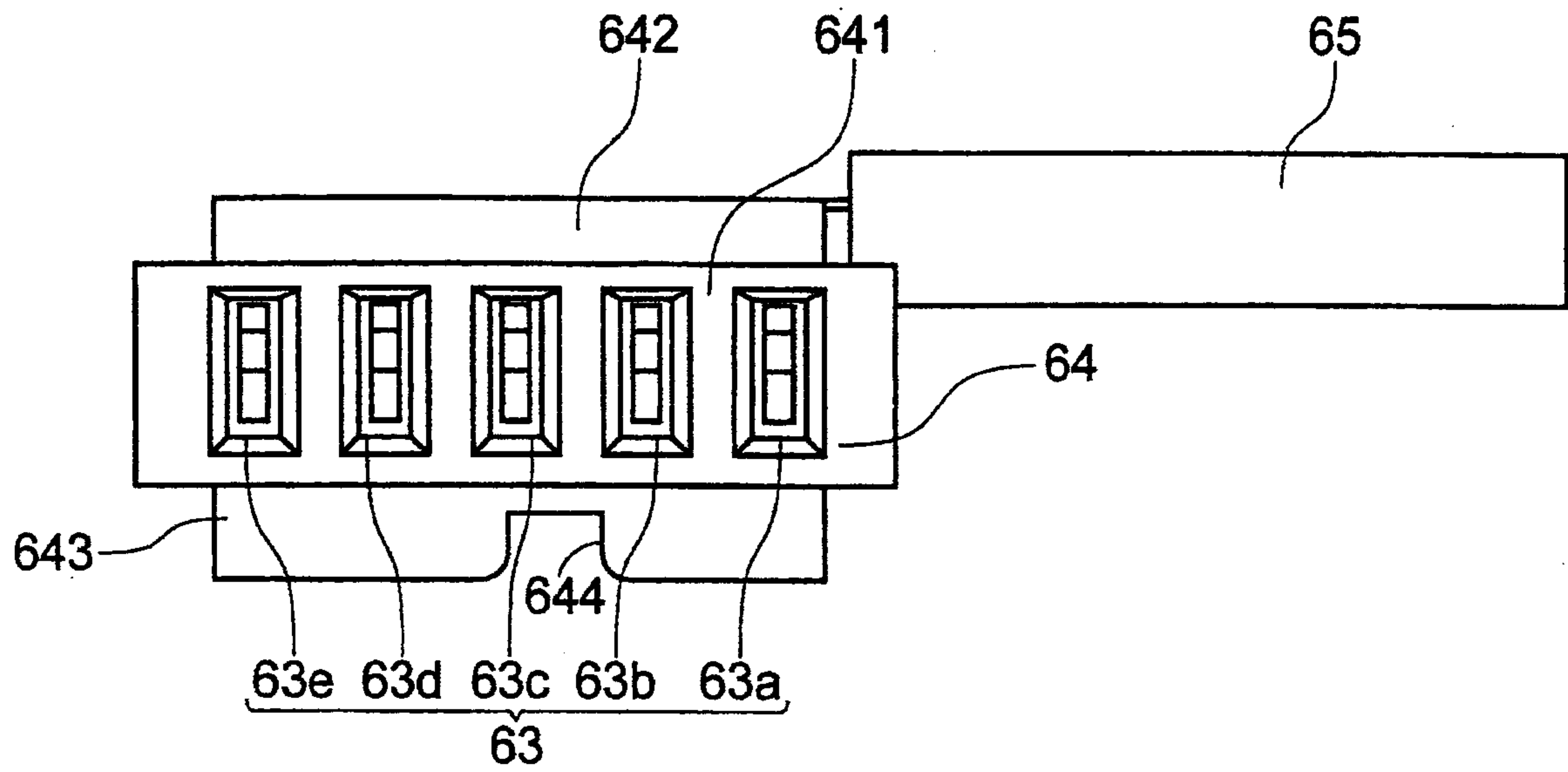


FIG. 23

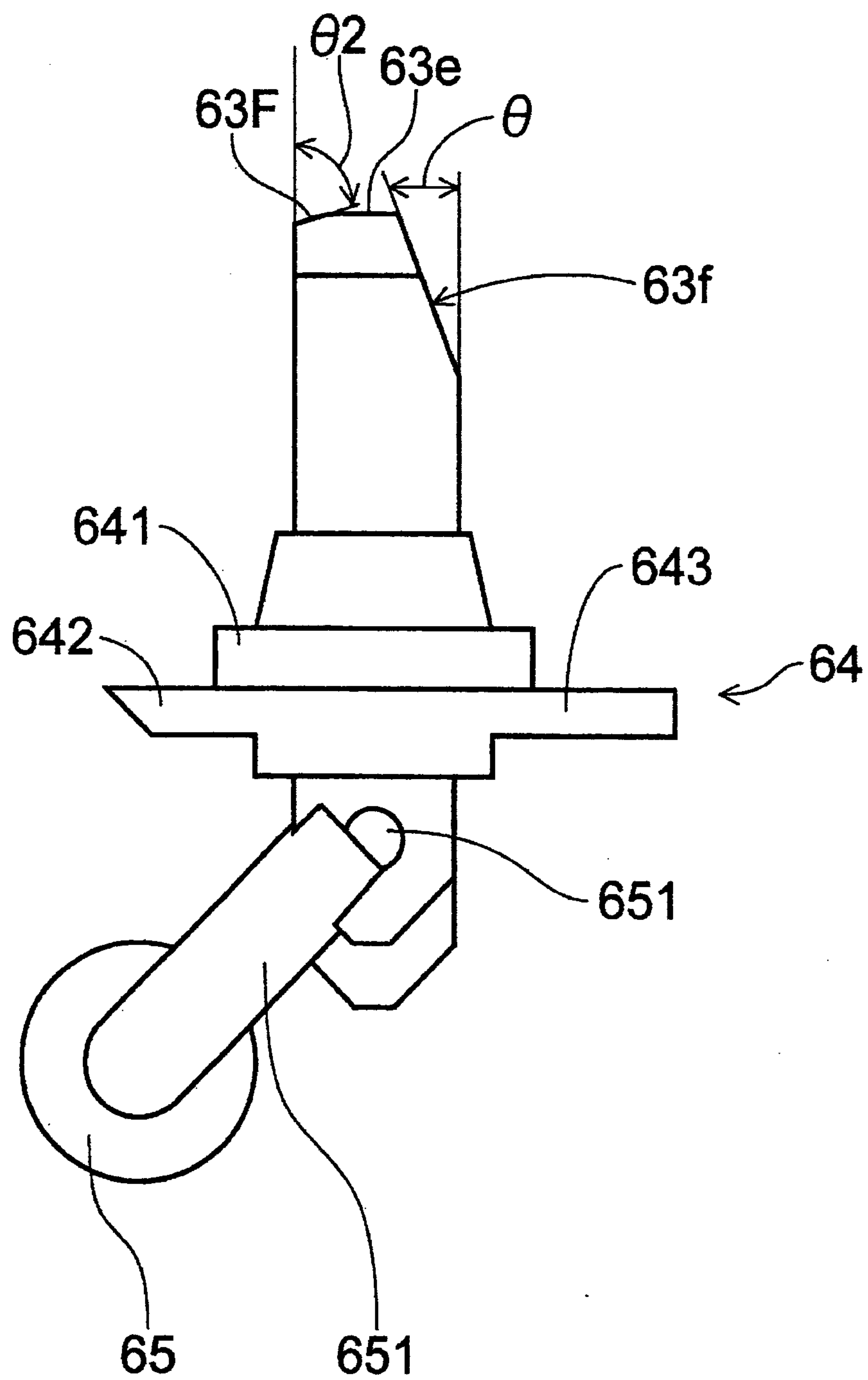


FIG. 24

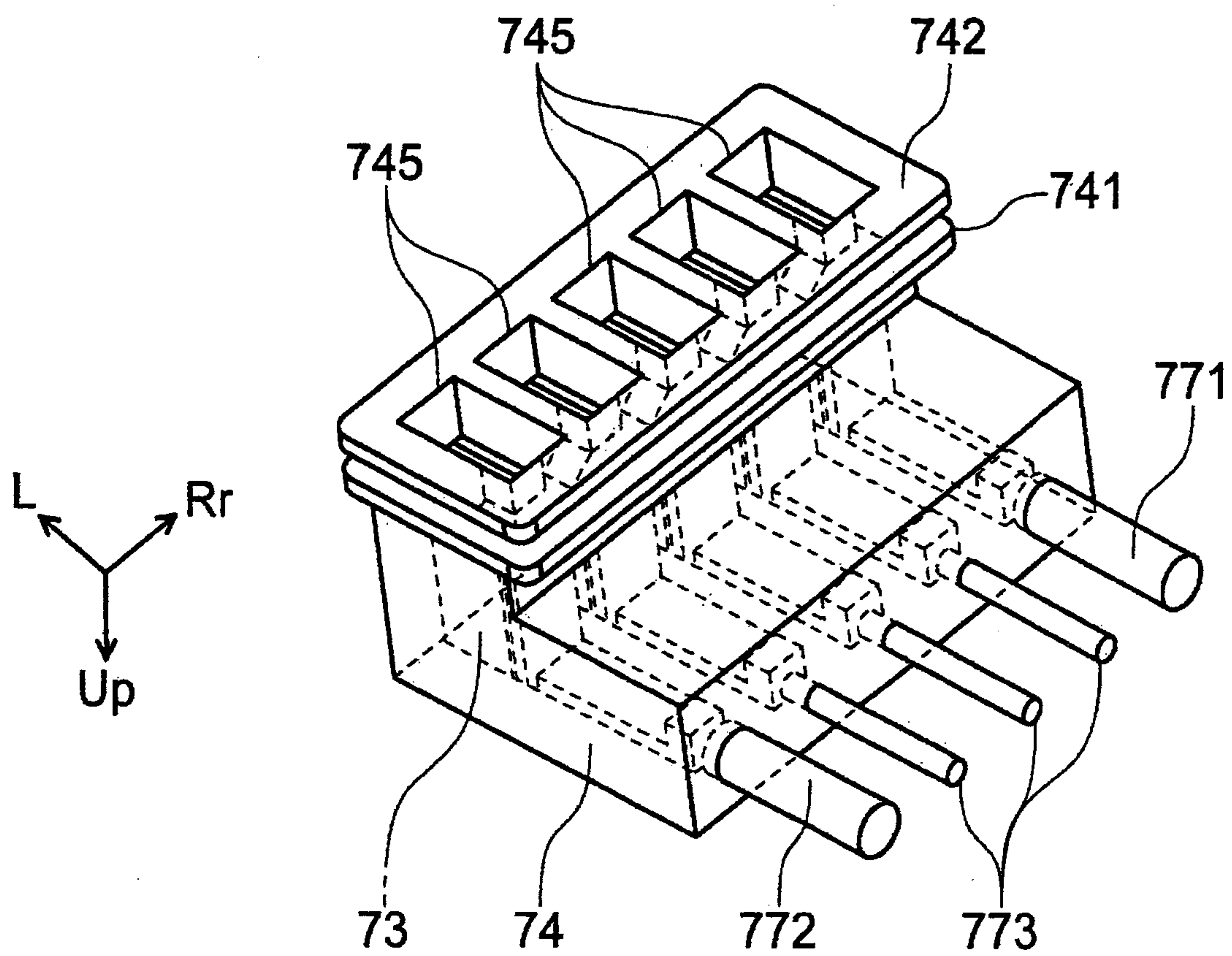


FIG. 25

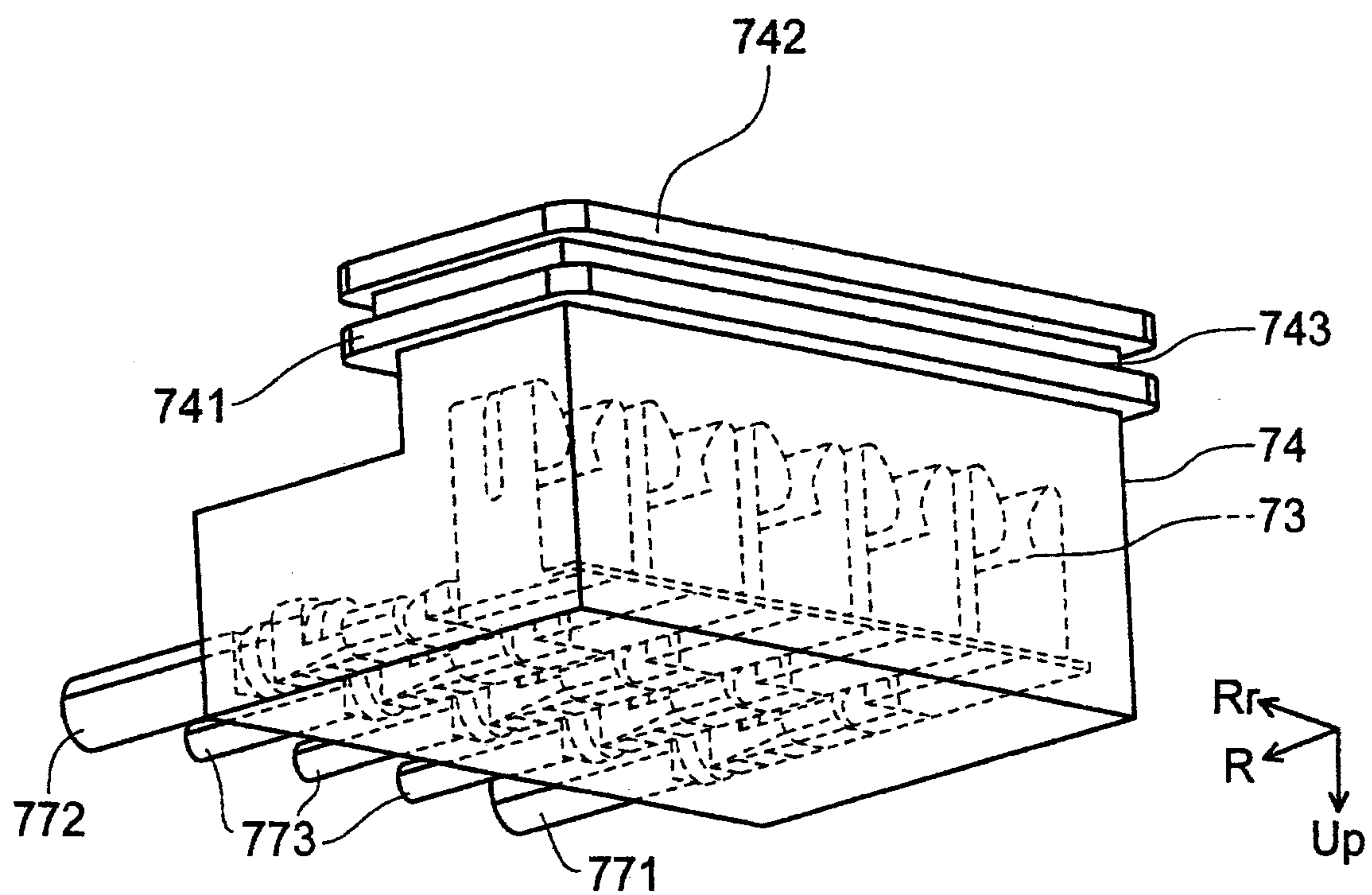


FIG. 26

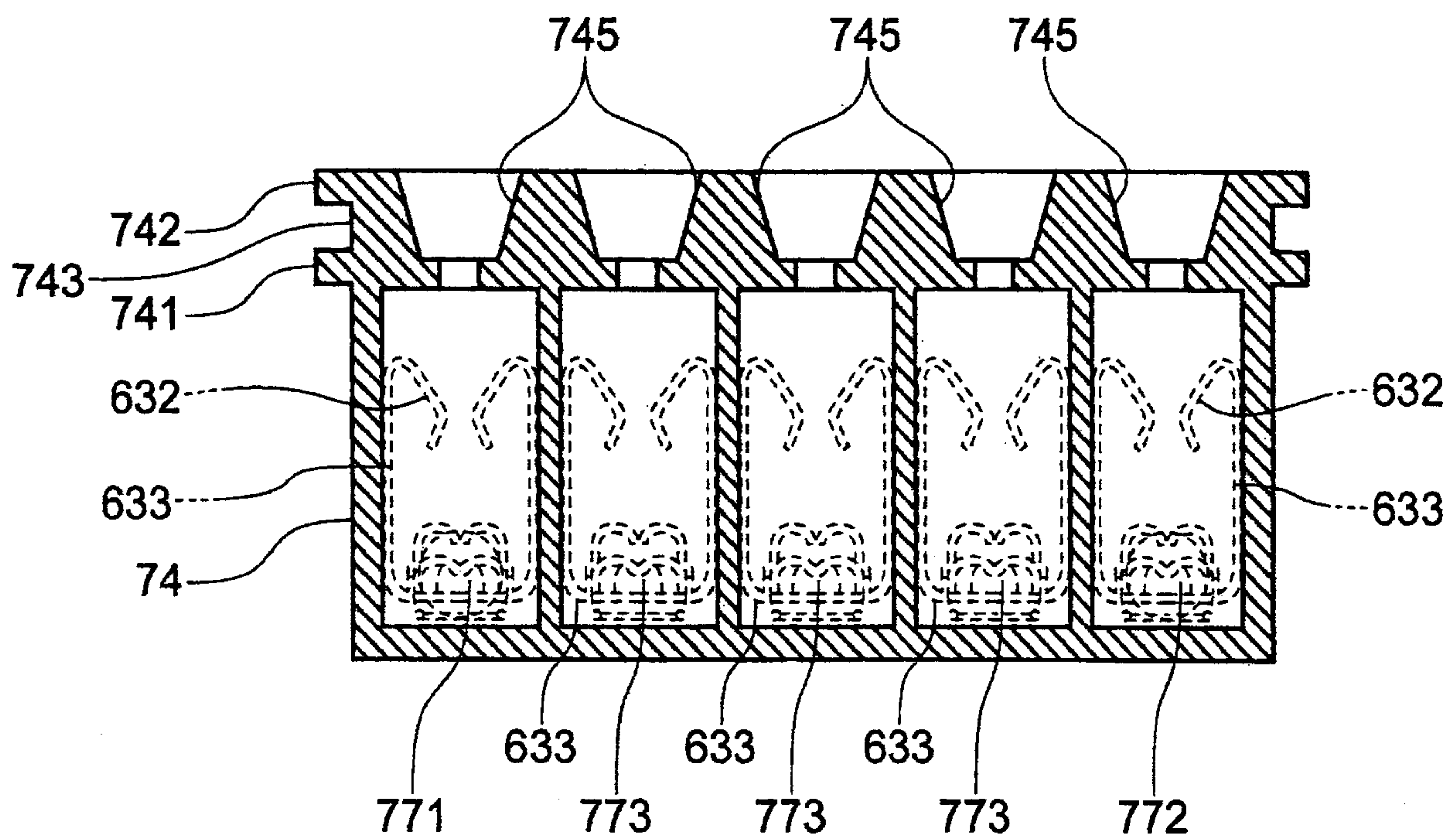


FIG. 27A

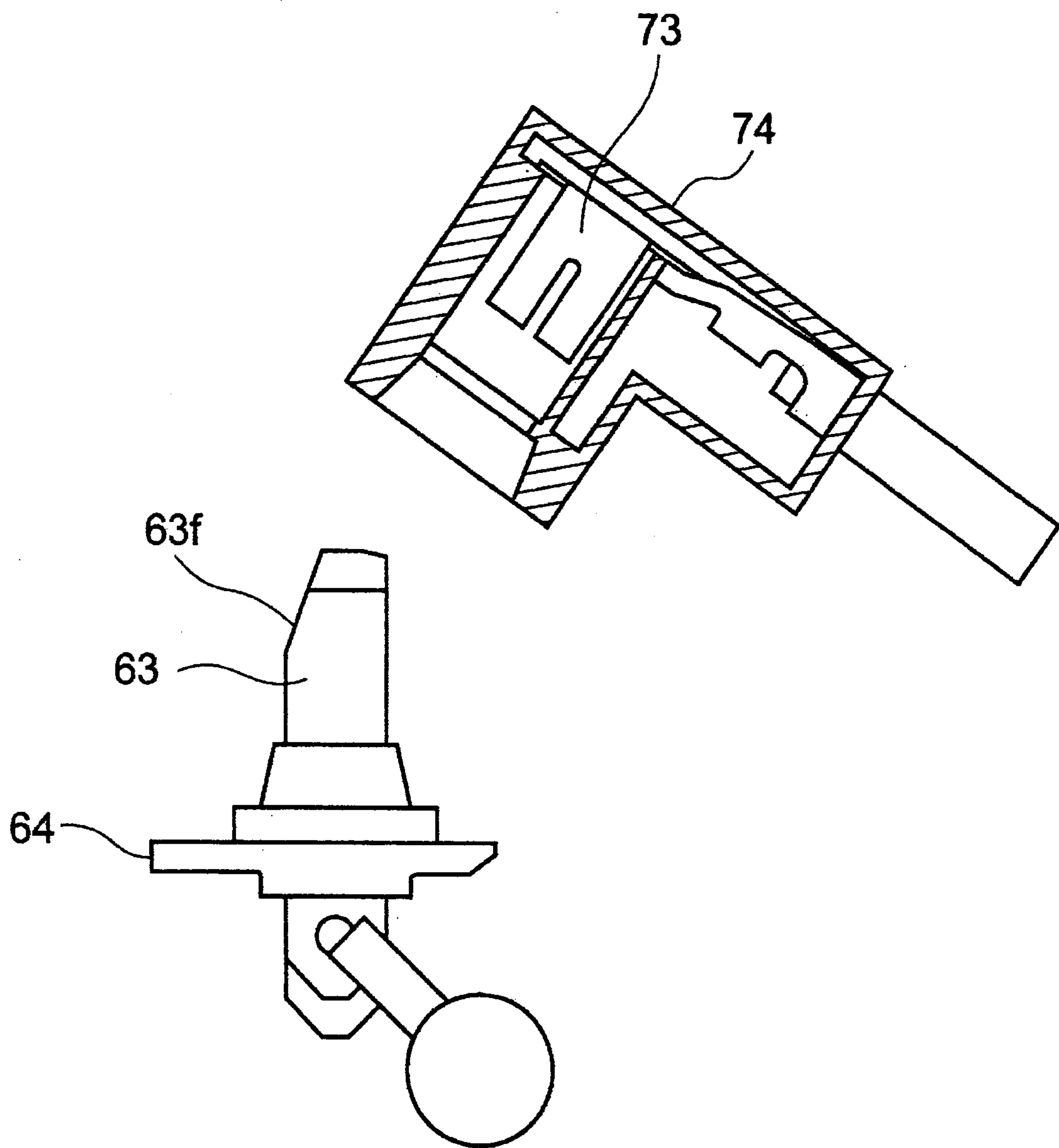


FIG. 27B

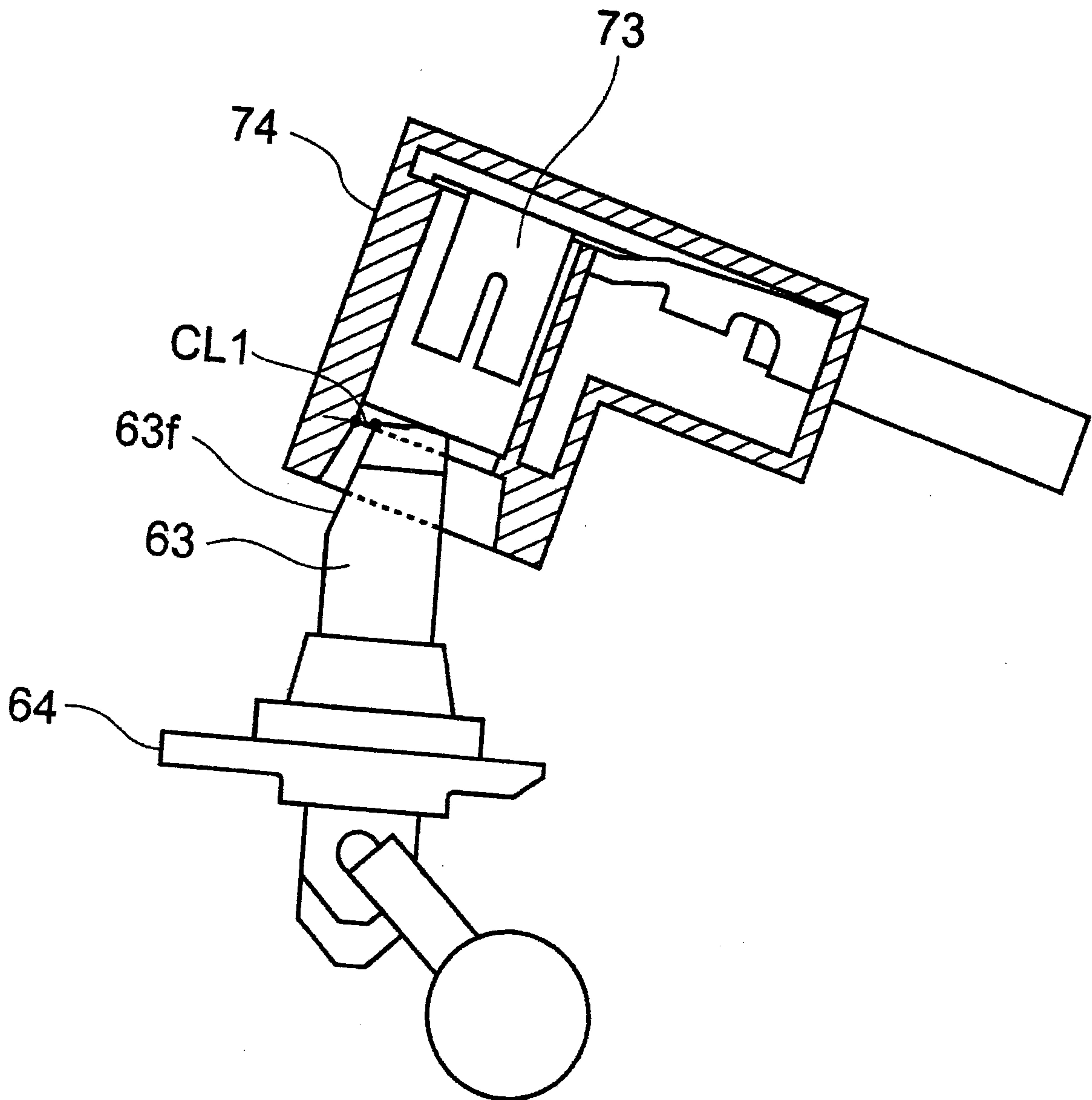


FIG. 27C

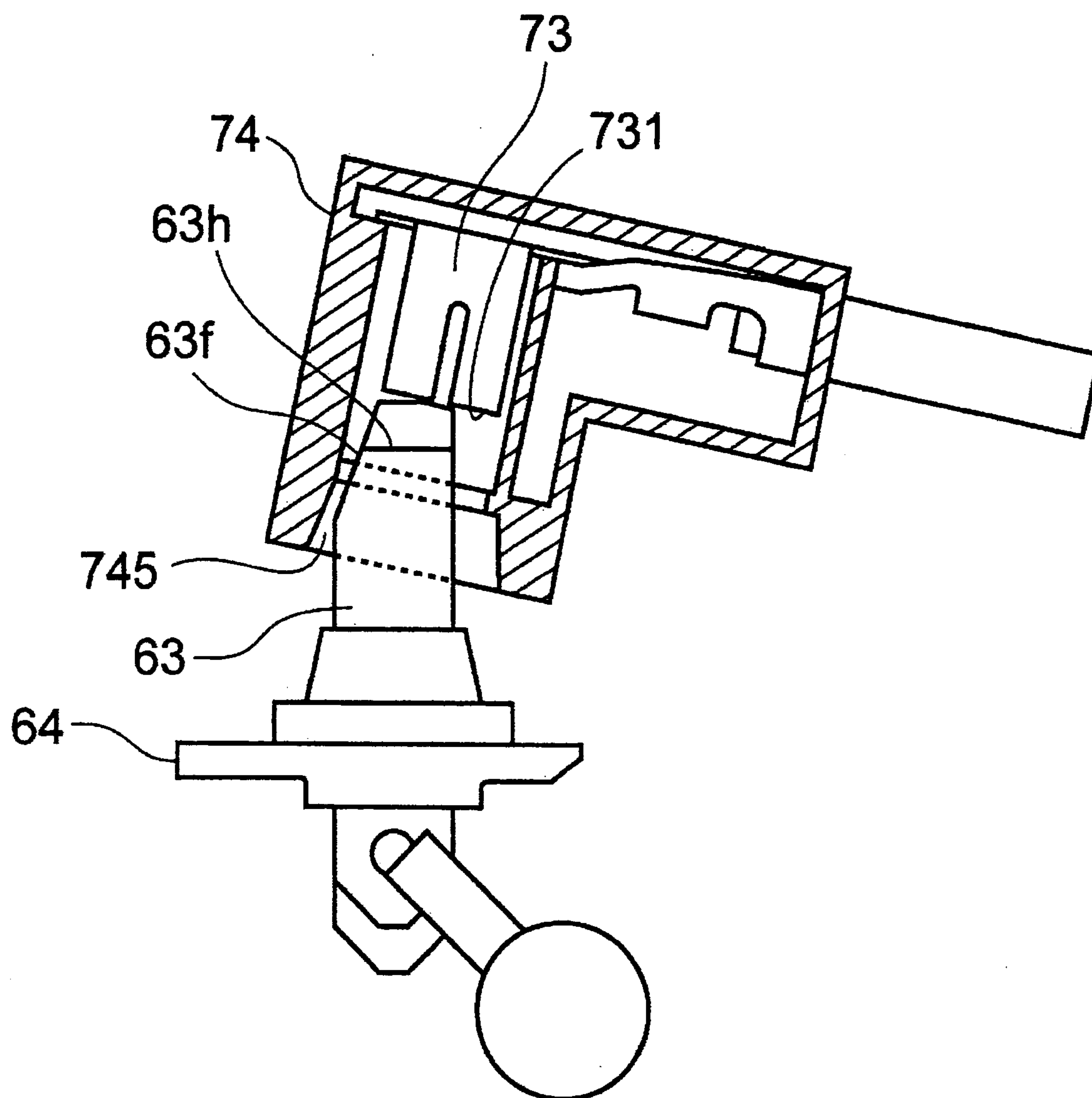


FIG. 27D

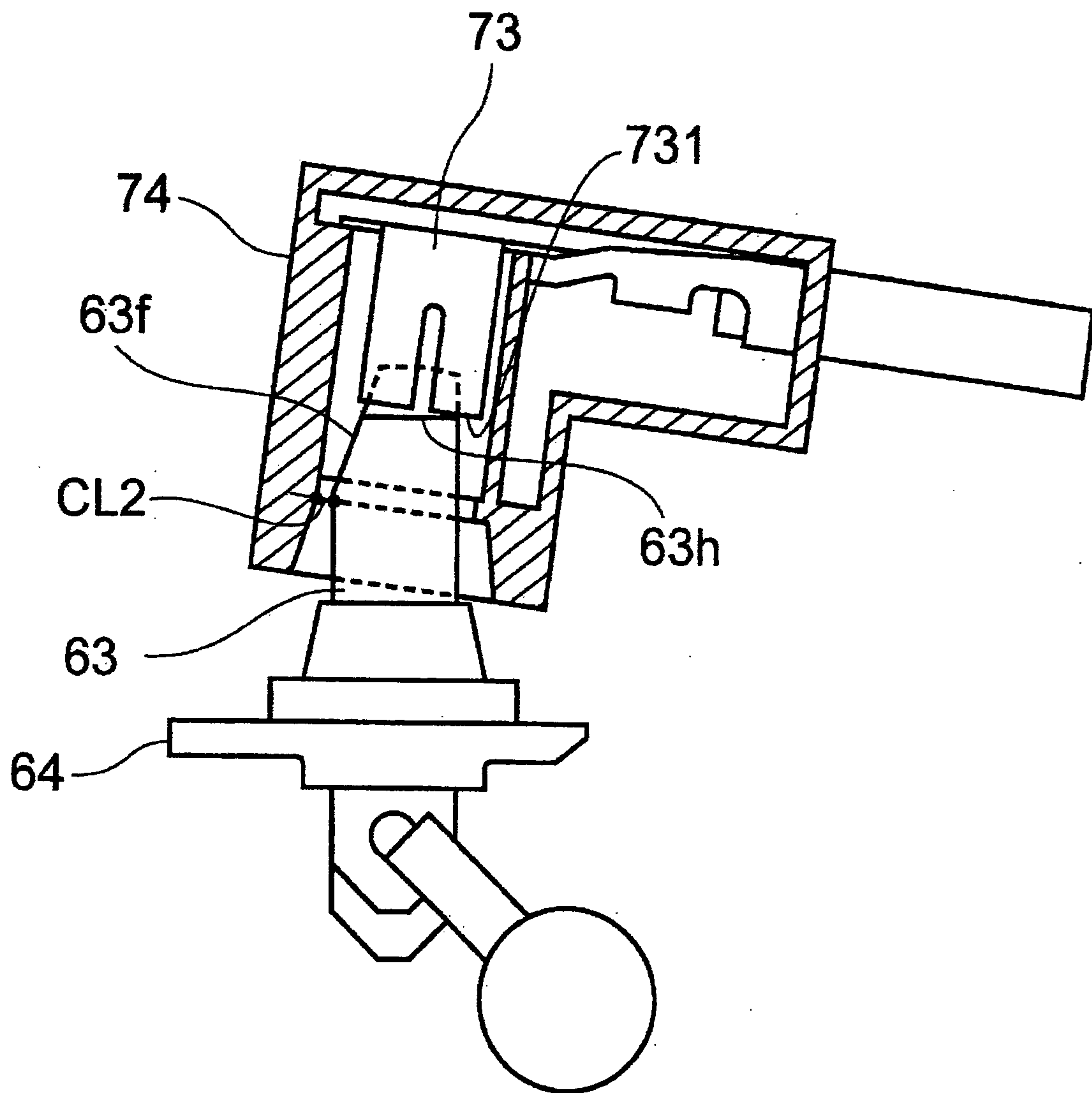


FIG. 27E

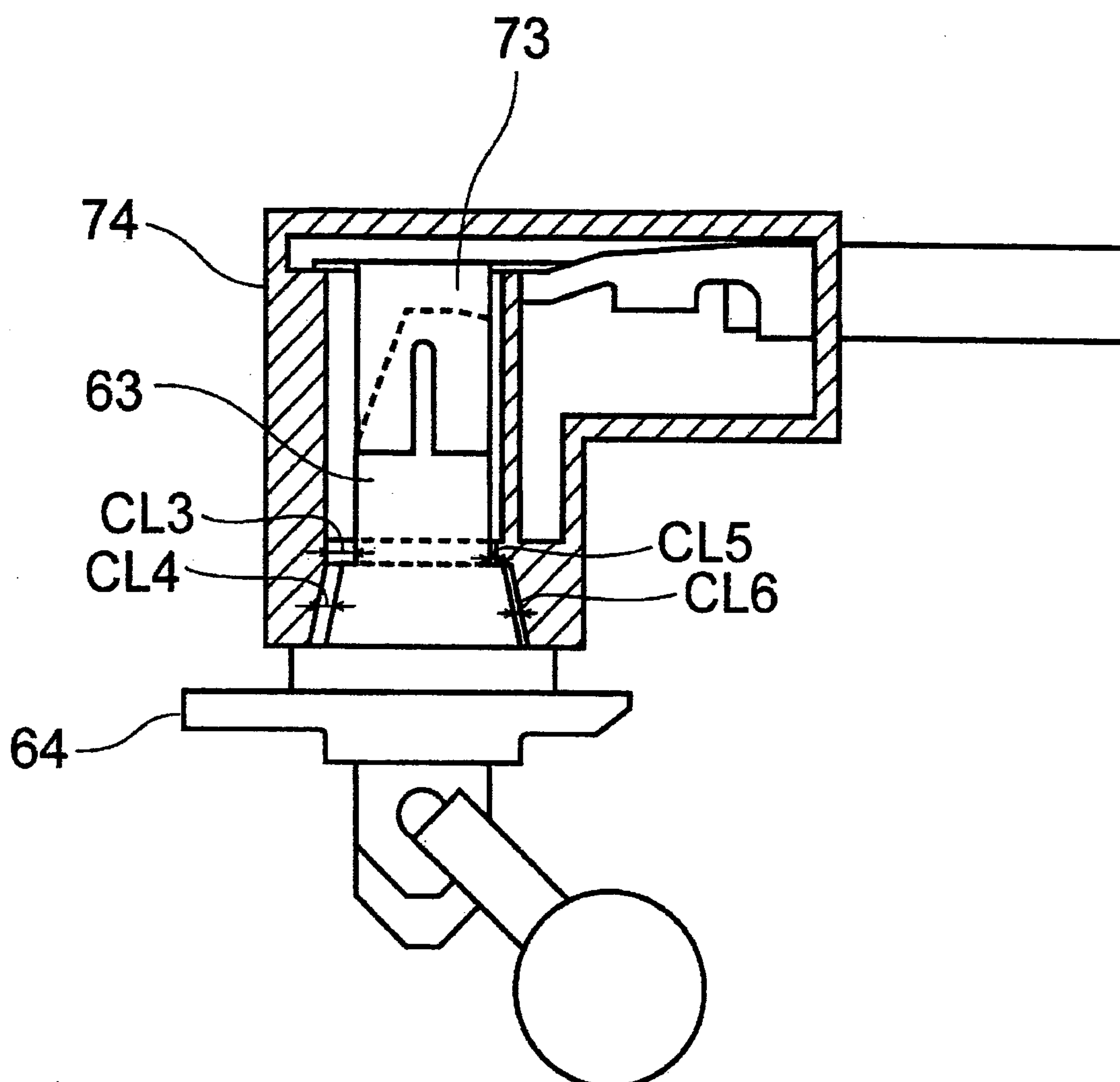


FIG. 28

