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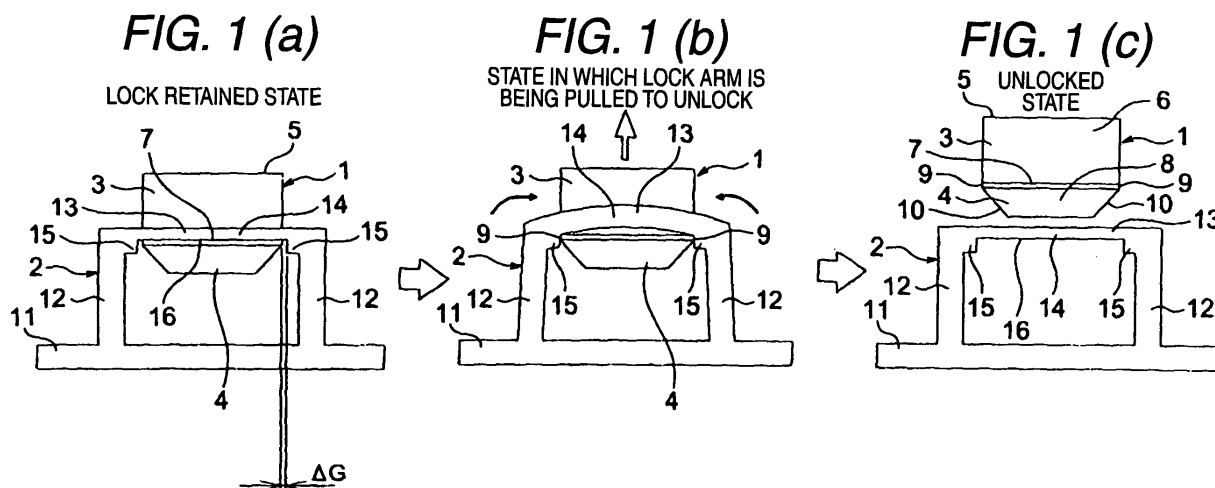
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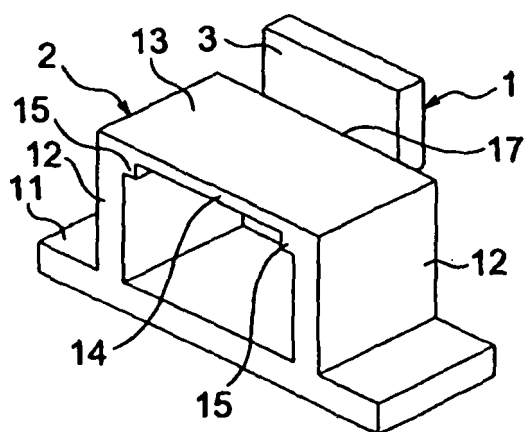
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(54) **Lock structure and cover lock structure of terminal cap**

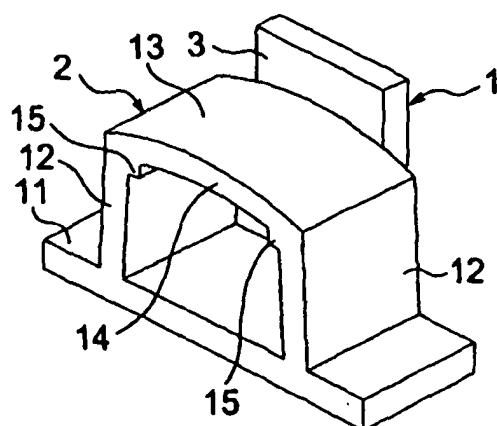
(57) At the time of cancellation of a lock retained state, in conjunction with the withdrawal of a lock arm 1, a thin-walled lock receiving portion 14 is pulled up by a lock portion 4, which causes the thin-walled lock receiving portion 14 to deflect toward the outer side and a pair of side walls 9 to deflect toward the inner side. At this

time, free play  $\Delta G$  disappears, and the lock portion 4 is movably supported in such that both side portions 9 are clamped by a pair of lock guide portions 15. Subsequently, when the lock portion 4 is removed from a retaining wall 13, the cancellation of the lock retained state is completed.

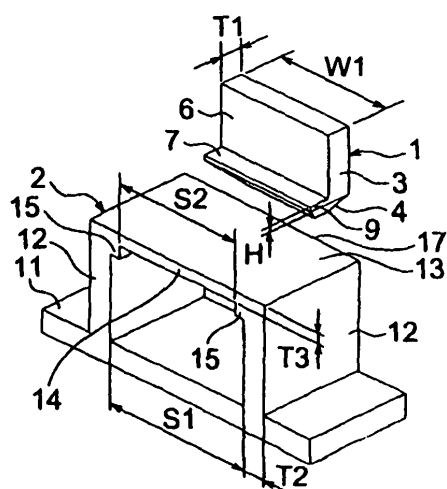




**FIG. 1 (d)**



**FIG. 1 (e)**



**FIG. 1 (f)**

## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the invention

[0001] The present invention relates to a lock structure comprised of a lock receiving frame and a lock arm, and to a cover lock structure of a terminal cap in which this lock structure is adopted.

#### 2. Description of the related art

[0002] A terminal cap is conventionally known as a cap for covering a terminal (connection terminal) which is provided at a terminal end of an electric wiring and is connected to a connection terminal of an electric apparatus, and whose shape in a side view is L-shaped. The terminal cap has the functions of providing insulation so as to prevent the leakage of electric current and providing protection to prevent attachment of water or dust to the terminal and the connection terminal of the electric apparatus. The terminal cap is generally formed by injection molding an insulating synthetic resin material.

[0003] The terminal cap disclosed in patent document 1 below is comprised of a cap body for accommodating a terminal which has a bent portion and whose shape in a side view is L-shaped, as well as a plurality of covers for covering an opening on the terminal-accommodating side of this cap body. The plurality of covers are of three types, i.e., a first cover to a third cover. The first cover is formed so as to be able to cover the opening at a position corresponding to an electric wire connecting portion of the terminal. The second cover is formed so as to be able to cover the opening at a position corresponding to the bent portion of the terminal. The third cover is formed so as to be able to cover the opening at a position corresponding to an electric contact portion of the terminal.

[0004] The third cover is formed continuously with the second cover by means of a very thin hinge. The third cover is not closed until the electric contact portion of the terminal is connected to the connection terminal of an electric apparatus. Until then, the open state is maintained as a lock arm formed on the third cover is caught and retained by a retaining recessed portion of the second cover.

[0005] After the electric contact portion of the terminal is connected to the connection terminal of the electric apparatus, if the lock retained state is canceled such as by withdrawing the lock arm, the opening at the position corresponding to the electric contact portion of the terminal can be covered by the third cover.

Patent Document 1: JP-A-2004-253223

[0006] With the above-described conventional art, when the state of lock retention between the third cover and the second cover is canceled, if there is free play between the lock arm and the retaining recessed portion (the free play can be caused in the widthwise direction

of the lock arm perpendicular to the withdrawing direction of the lock arm; the free play results from such as design tolerances and product tolerances), the withdrawing direction of the lock arm does not stabilize, so that a twist can possibly be applied to the hinge connecting the third cover. Further, at this time, if a large load is applied to the hinge, breakage can occur in the hinge. The above-described conventional art has such a problem.

[0007] It should be noted that the free play between the lock arm and the retaining recessed portion is not limited to the lock structure of the cover in the terminal cap.

### SUMMARY OF THE INVENTION

[0008] The present invention has been devised in view of the above-described circumstances, and its object is to provide a lock structure that is capable of stabilizing the withdrawing direction of the lock arm at the time of cancellation of the lock retained state. Another object of the invention is to provide a cover lock structure of a terminal cap capable of reducing the load applied to the hinge.

[0009] To attain the above object, in accordance with a first aspect of the invention there is provided a lock structure comprising: a frame-shaped lock receiving frame including a pair of mutually opposing side walls, a thin-walled lock receiving portion which is thinner than each of the side walls, and a pair of lock guide portions which are respectively formed on both sides of the thin-walled lock receiving portion; and a lock arm including an arm portion and a lock portion having a substantially claw-like shape and formed projectingly on the arm portion, wherein as the lock portion enters an inner side of the lock receiving frame, the thin-walled lock receiving portion and the lock portion are caught by each other to thereby form a lock retained state, and wherein at the time of cancellation of the lock retained state, in conjunction with the withdrawal of the lock arm, the thin-walled lock receiving portion is pulled up by the lock portion, which causes the thin-walled lock receiving portion to deflect and the pair of the side walls to deflect toward the inner side, to thereby allow both side portions of the lock portion to be clamped and movably supported by the pair of the lock guide portions.

[0010] A cover lock structure of a terminal cap according to a second aspect of the invention devised to overcome the above object is **characterized in that** the lock structure according to the above-described first aspect is adopted as a lock structure between two covers which are connected to each other by a hinge in an insulating terminal cap which is used for accommodating and protecting an electrically conductive terminal.

[0011] In accordance with the invention according to the above-described first aspect, an advantage is offered in that it is possible to stabilize the withdrawing direction of the lock arm at the time of cancellation of the lock retained state by virtue of the shape of the lock receiving

frame. Thus, an advantage is offered in that it is possible to reduce the load that is otherwise applied to portions other than the lock structure.

**[0012]** In accordance with the invention according to the above-described second aspect, an advantage is offered in that by stabilizing the withdrawing direction of the lock arm, it is possible to reduce the load applied to the hinge by suppressing a twist.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

##### **[0013]**

Figs. 1A to 1F are schematic diagrams illustrating an embodiment of the lock structure in accordance with the invention, in which Fig. 1A is a front elevational view; Fig. 1B is a front elevational view illustrating a state in which a lock arm is being pulled to cancel the lock; Fig. 1C is a front elevational view illustrating a state in which the lock has been canceled; Fig. 1D is a perspective view illustrating a lock retained state; Fig. 1E is a perspective view illustrating a state in which the lock arm is being pulled to cancel the lock; and Fig. 1F is a perspective view illustrating a state in which the lock has been canceled;

Figs. 2A and 2B are diagrams illustrating an embodiment of the cover lock structure, in which Fig. 2A is a perspective view of the terminal cap illustrating a state in which the terminal is accommodated and before the cover is closed, and Fig. 2B is a perspective view of the terminal cap illustrating a state in which the cover is closed;

Fig. 3 is a perspective view illustrating the terminal cap in which the third cover and the second cover are in a lock retained state;

Fig. 4 is a plan view of the terminal cap shown in Fig. 3;

Fig. 5A is a cross-sectional view taken along line E - E in Fig. 4;

Fig. 5B is an enlarged view of a portion J shown in Fig. 5A;

Fig. 6A is a side elevational view of the terminal cap shown in Fig. 3;

Fig. 6B is a rear view of the terminal cap shown in Fig. 3;

Fig. 7A is a cross-sectional view taken along line D - D in Fig. 6A;

Fig. 7B is an enlarged view of a portion I shown in Fig. 7A; and

Fig. 8 is an enlarged view illustrating a comparative example of the cover lock structure.

#### **DESCRIPTION OF THE PREFERRED EMBODIMENTS**

**[0014]** Hereafter, a description will be given with reference to the drawings. Figs. 1A to 1F are schematic

diagrams illustrating an embodiment of the lock structure in accordance with the invention, in which Fig. 1A is a front elevational view; Fig. 1B is a front elevational view illustrating a state in which a lock arm is being pulled to cancel the lock; Fig. 1C is a front elevational view illustrating a state in which the lock has been canceled; Fig. 1D is a perspective view illustrating a lock retained state; Fig. 1E is a perspective view illustrating a state in which the lock arm is being pulled to cancel the lock; and Fig. 1F is a perspective view illustrating a state in which the lock has been canceled.

**[0015]** In Figs. 1A to 1F, the lock structure in accordance with the invention is comprised of a lock arm 1 and a lock receiving frame 2. Although not particularly shown in this embodiment, the lock arm 1 is provided on a movable part or portion made of a synthetic resin, while the lock receiving frame 2 is provided on a part or portion which is nonrotatable (relatively nonrotatable with respect to the lock arm 1 side) and is made of a synthetic resin.

**[0016]** The lock arm 1 has an arm portion 3 and a lock portion 4. The lock arm 1 is integrated with the aforementioned part or portion whose position designated by reference numeral 5 is movable. The arm portion 3 is formed in a plate-like shape having a predetermined wall thickness T1 and a predetermined width W1. (The arm portion 3 is formed so as to be rectangular in a front view in this embodiment; this shape is only exemplary.) Further, the arm portion 3 is formed so as to be flexible. The lock portion 4 is formed continuously with an end portion of such an arm portion 3.

**[0017]** The lock portion 4 is formed so as to project forward from a front surface 6 of the arm portion 3. The lock portion 4 has a lock-side retaining surface 7 and is thereby formed in a substantially claw-like shape. The lock-side retaining surface 7 is a flat surface extending in the widthwise direction of the arm portion 3 and is formed so as to be perpendicular to the front surface 6. The lock portion 4 is formed as a portion which enters the inner side of the lock receiving frame 2 and is caught by this lock receiving frame 2, thereby setting the lock arm 1 and the lock receiving frame 2 in a lock retained state.

**[0018]** A taper 8, which is brought into sliding contact with the lock receiving frame 2 immediately before the aforementioned lock retained state, is formed on the lock portion 4. Further, a pair of side portions 9 constituting opposite side portions in the aforementioned widthwise direction and a pair of side portion tapers 10 respectively continuing from the pair of side portions 9 are formed on the lock portion 4. Each side portion 9 is set such that a height H thereof is sufficiently low. In this embodiment, the lock portion 4 is formed such that the width thereof, an interval between the side portions 9, and the width of the lock-side retaining surface 7 are identical to a width W1 of the arm portion 3 (these settings are only exemplary).

**[0019]** The lock receiving frame 2 has a pair of side

walls 12 rising upward from a base 11 and opposing each other, as well as a retaining wall 13 spanning distal ends of this pair of side walls 12, and is thereby formed substantially in the shape of a U-shaped frame. The pair of sidewalls 12 are formed as walls projecting in a perpendicular direction to the base 11. In addition, the pair of sidewalls 12 are formed so as to be disposed such that an interval S1 therebetween is wider than the width (W1) of the lock portion 4. The wall thickness of each of the pair of side walls 12 is set to such a wall thickness T2 as to allow the side walls 12 to be slightly deflected inward.

**[0020]** The retaining wall 13 has a thin-walled lock receiving portion 14 and a pair of lock guide portions 15 respectively formed on both sides of this thin-walled lock receiving portion 14. In this embodiment, the thin-walled lock receiving portion 14 and the pair of lock guide portions 15 are formed in such a state that a wall is recessed. In other words, the thin-walled lock receiving portion 14 is formed to be thinner than the side walls 12 ( $T2 > T3$ ). In addition, the thin-walled lock receiving portion 14 is formed so as to be deflected more easily than the side walls 12. The thin-walled lock receiving portion 14 is formed so that the inner side of the lock receiving frame 2 is recessed.

**[0021]** In this embodiment, the pair of lock guide portions 15 are portions created by the recessing for forming the thin-walled lock receiving portion 14, and are formed so that when deflection occurs in the thin-walled lock receiving portion 14 and the pair of side walls 12, the pair of lock guide portions 15 are set in such a form as to clamp the both side portions 9 of the lock portion 4 and to be able to guide the lock portion 4.

**[0022]** The pair of lock guide portions 15 are formed such that an interval S2 therebetween conforms to the width (W1) of the lock portion 4. The interval S2 of the pair of lock guide portions 15 and the width (W1) of the lock portion 4 are set such that a zero or minimum free play  $\Delta G$  is produced in terms of a dimensional tolerance.

**[0023]** Concerning the retaining wall 13, reference numeral 16 denotes a receiving-side retaining surface, and reference numeral 17 denotes a lock sliding-contact portion. The receiving-side retaining surface 16 is formed to constitute a portion (a surface for retention) that is brought into surface contact with the lock-side retaining surface 7 of the lock portion 4. The lock sliding-contact portion 17 is formed as a portion with which the taper 8 of the lock portion 4 is brought into sliding contact immediately before assuming the lock retained state.

**[0024]** Next, a description will be given of the lock structure in accordance with the invention on the basis of the above-described construction and structure. As the lock portion 4 of the lock arm 1 enters the inner side of the lock receiving frame 2, the receiving-side retaining surface 16 of the thin-walled lock receiving portion 14 and the lock-side retaining surface 7 of the lock portion 4 are caught by each other, thereby forming the lock retained state (see Figs. 1A to 1D).

**[0025]** Meanwhile, at the time of cancellation of the

lock retained state, in conjunction with the withdrawal of the lock arm 1, the thin-walled lock receiving portion 14 is pulled up by the lock portion 4 (see Figs. 1B and 1E). This causes the thin-walled lock receiving portion 14 to deflect toward the outer side and the pair of side walls 9 to deflect toward the inner side. At this time, the free play  $\Delta G$  disappears, and the lock portion 4 is movably supported in such a form that the both side portions 9 are clamped by the pair of lock guide portions 15. (It should be noted that, there are cases where the pair of lock guide portions 15 guide the side portion tapers 10, depending on the degree of the aforementioned deflection.) Subsequently, when the lock portion 4 is removed from the retaining wall 13, the cancellation of the lock retained state is completed (see Figs. 1C and 1F).

**[0026]** As a description has been given above with reference to Figs. 1A to 1F, according to the invention, it is possible to stabilize the withdrawing direction of the lock arm 1 at the time of cancellation of the lock retained state by virtue of the shape of the lock receiving frame 2. Therefore, according to the invention, it is possible to reduce or eliminate the load that is otherwise applied to portions other than the lock structure.

**[0027]** Next, referring to Figs. 2A to 8, a description will be given of a cover lock structure of a terminal cap in accordance with the invention. Figs. 2A and 2B are diagrams illustrating an embodiment of the cover lock structure. Fig. 2A is a perspective view of the terminal cap illustrating a state in which the terminal is accommodated and before the cover is closed, and Fig. 2B is a perspective view of the terminal cap illustrating a state in which the cover is closed.

**[0028]** In addition, Fig. 3 is a perspective view illustrating the terminal cap in which the third cover and the second cover are in a lock retained state. Fig. 4 is a plan view of the terminal cap shown in Fig. 3. In addition, Fig. 5A is a cross-sectional view taken along line E - E in Fig. 4, and Fig. 5B is an enlarged view of a portion J shown in Fig. 5A. Fig. 6A is a side elevational view of the terminal cap shown in Fig. 3, and Fig. 6B is a rear view of the terminal cap shown in Fig. 3. Fig. 7A is a cross-sectional view taken along line D - D in Fig. 6A, and Fig. 7B is an enlarged view of a portion I shown in Fig. 7A. In addition, Fig. 8 is an enlarged view illustrating a comparative example of the cover lock structure.

**[0029]** In Figs. 2 and 3, reference numeral 21 denotes a terminal that is connected to a stud bolt-like connection terminal of an unillustrated electric apparatus (e.g., a starter of a motor vehicle). The terminal 21 is formed by bending an electrically conductive and relatively thick metal plate. The terminal 21 is formed into a shape that has a bent portion 22 and is L-shaped in a side view.

**[0030]** One bent piece of the terminal 21 with the bent portion 22 located in between serves as an electric contact portion 23, while the other bent piece thereof serves as a relay portion 24. A stud bolt 25 is inserted in the relay portion 24. A second terminal (not shown) which is provided at a terminal end of an electric wiring (electric

wire) is adapted to be connected to the terminal 21 through this stud bolt 25.

**[0031]** In Figs. 2 to 7, a terminal cap 31 is formed of an insulative synthetic resin material and is comprised of a cap body 32 for accommodating the terminal 21 and a cover 33 for covering an opening (an opening on the accommodating side of the terminal 21; its reference numeral is omitted) of this cap body 32.

**[0032]** The cap body 32 includes an electric-contact-portion corresponding portion 34 corresponding to the electric contact portion 23 of the terminal 21; a bent-portion corresponding portion 35 corresponding to the bent portion 22 of the terminal 21; a relay-portion corresponding portion 36 corresponding to the relay portion 24 of the terminal 21; and an electric-wire-connecting-portion corresponding portion 37 corresponding to an electric-wire connecting portion of the un-illustrated second terminal.

**[0033]** The cover 33 is comprised of a first cover 40 and a second cover 41 which are formed continuously with the cap body 32 by means of hinges 38 and 39, respectively, and a third cover 43 which is formed continuously with the second cover 41 by means of a hinge 42.

**[0034]** The first cover 40 is formed in such a manner as to cover the openings of the relay-portion corresponding portion 36 and the electric-wire-connecting-portion corresponding portion 37, and is formed so as to be retained by the sidewall of the electric-wire-connecting-portion corresponding portion 37. The second cover 41 is formed in such a manner as to cover the opening of the bent-portion corresponding portion 35, and is formed so as to be retained by the sidewall of the bent-portion corresponding portion 35. The third cover 43 is formed in such a manner as to cover the opening of the electric-contact-portion corresponding portion 34, and is formed so as to be retained by the sidewall of the electric-contact-portion corresponding portion 34.

**[0035]** The third cover 43 is not closed until the electric contact portion 23 of the terminal 21 is connected to the connection terminal of the electric apparatus. Until then, the open state is maintained as the lock arm 1 formed on the third cover 43 is caught and retained (is set in the lock retained state) by the lock receiving frame 2 formed on the second cover 41.

**[0036]** The lock arm 1 of the third cover 43 has the arm portion 3 and the lock portion 4 in the same way as has been described with reference to Figs. 1A to 1F. Also, the lock receiving frame 2 of the second cover 41 has the pair of side walls 12 and the retaining wall 13, and is thereby formed substantially in the shape of a U-shaped frame. The retaining wall 13 has the thin-walled lock receiving portion 14 and the pair of lock guide portions 15 respectively formed on both sides of this thin-walled lock receiving portion 14.

**[0037]** Since the terminal cap 31 has the lock arm 1 and the lock receiving frame 2 which are identical to those described with reference to Figs. 1A to 1F, the cover lock

structure in accordance with the invention is able to stabilize the withdrawing direction of the lock arm 1 at the time of cancellation of the lock retained state. Therefore, according to the invention, a twist is not applied to the hinge via the third cover 43, so that it is possible to reduce or eliminate the load that is otherwise applied to the hinge.

**[0038]** It should be noted that in a case where the recess of a thin-walled lock receiving portion 51 in accordance with a comparative example differs from the above-described invention (a large free play G is disadvantageously produced on each side of the lock portion 4), the lock portion 4 is not guided, with the result that a twist can possibly be applied to the hinge 42 via the third cover 43. If a large load is applied to the hinge 42, breakage can occur in the hinge 42. In the cover lock structure in accordance with the invention, it is possible to overcome such a problem.

**[0039]** In addition, it goes without saying that, in the invention, various changes may be made without departing from the scope of the invention.

**[0040]** It is to be understood that the lock structure in accordance with the invention can be adopted as various lock structures of not only the terminal cap 31 but also such as protectors.

## Claims

### 1. A lock structure, comprising:

a frame-shaped lock receiving frame, including a pair of mutually opposing side walls, a thin-walled lock receiving portion that is thinner than each of the side walls, and a pair of lock guide portions that are respectively formed on both sides of the thin-walled lock receiving portion; and

a lock arm including an arm portion and a lock portion having a substantially claw-like shape and projectingly formed on the arm portion, wherein as the lock portion enters an inner side of the lock receiving frame, the thin-walled lock receiving portion and the lock portion are caught by each other to thereby form a lock retained state, and

at the time of cancellation of the lock retained state, in conjunction with the withdrawal of the lock arm, the thin-walled lock receiving portion is pulled up by the lock portion, which causes the thin-walled lock receiving portion to deflect and the pair of the side walls to deflect toward the inner side, so as to allow both side portions of the lock portion to be clamped and movably supported by the pair of the lock guide portions.

### 2. The cover lock structure of a terminal cap wherein the lock structure according to claim 1 is adopted as a lock structure between two covers which are con-

nected to each other by a hinge in an insulating terminal cap that is used for accommodating and protecting an electrically conductive terminal.

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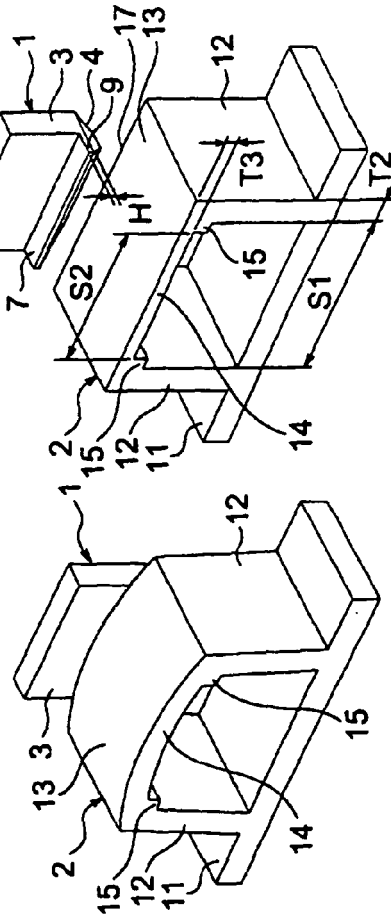
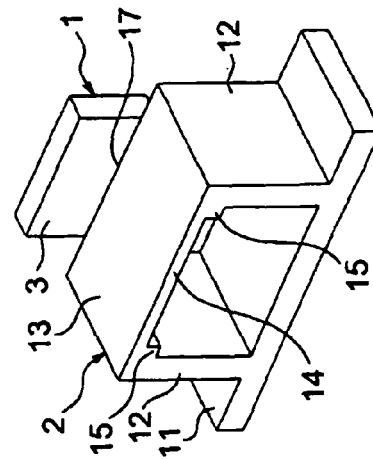
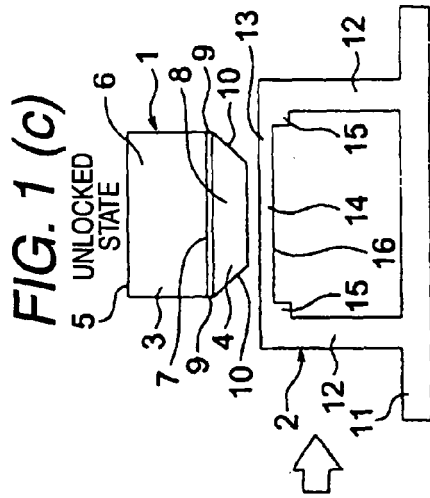
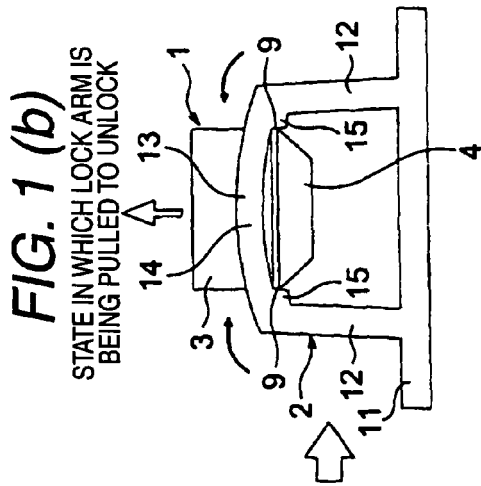
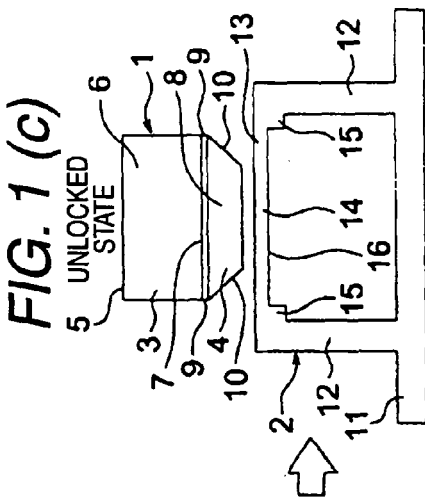
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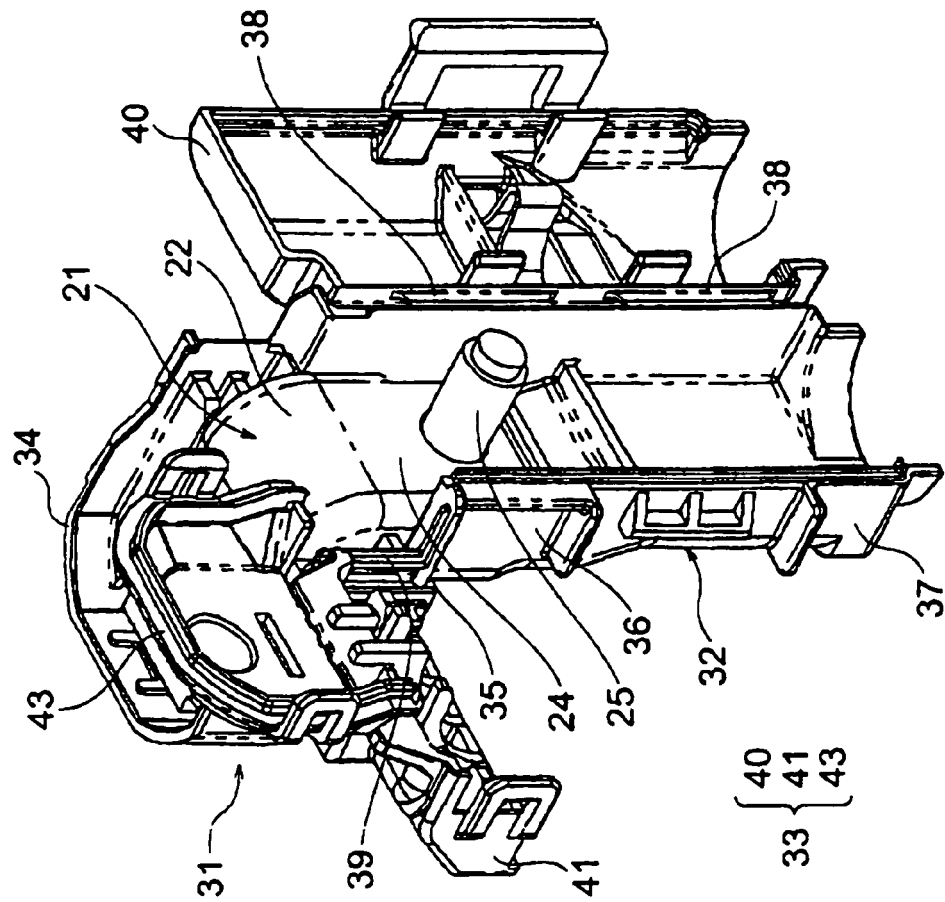


**FIG. 1 (f)**

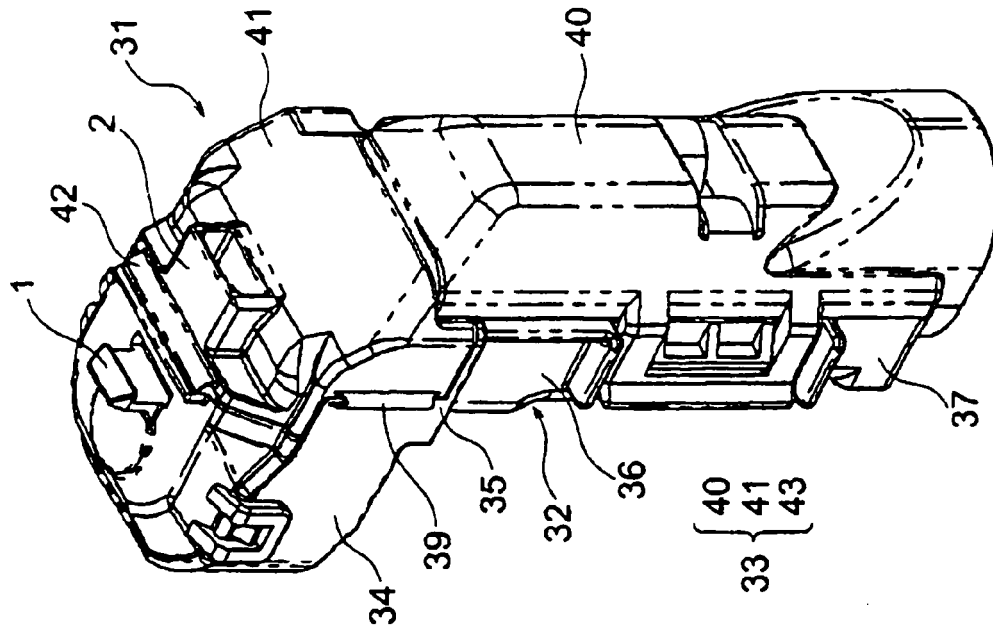
**FIG. 1 (e)**

**FIG. 1 (d)**

FIG. 2 (a)



**FIG. 2 (b)**



**FIG. 3**

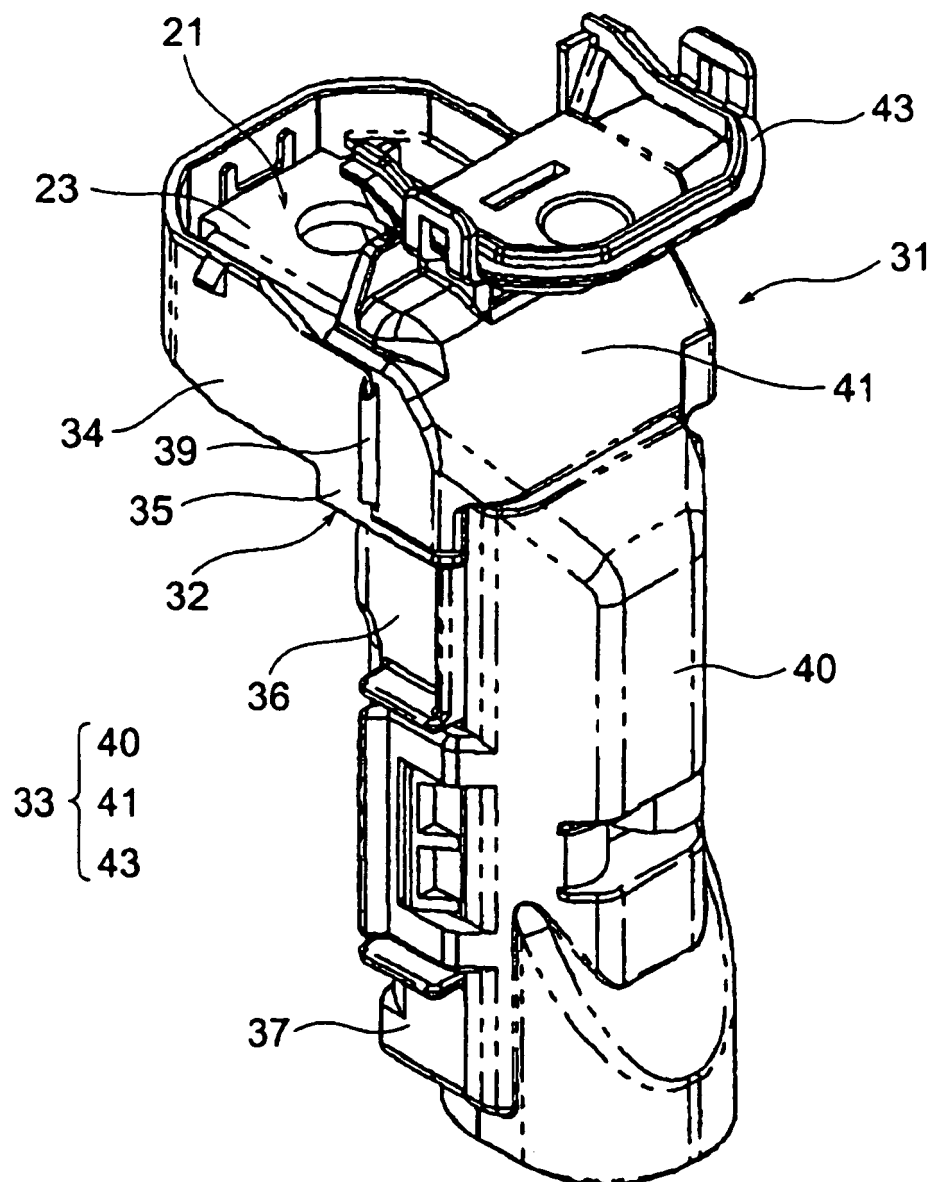


FIG. 4

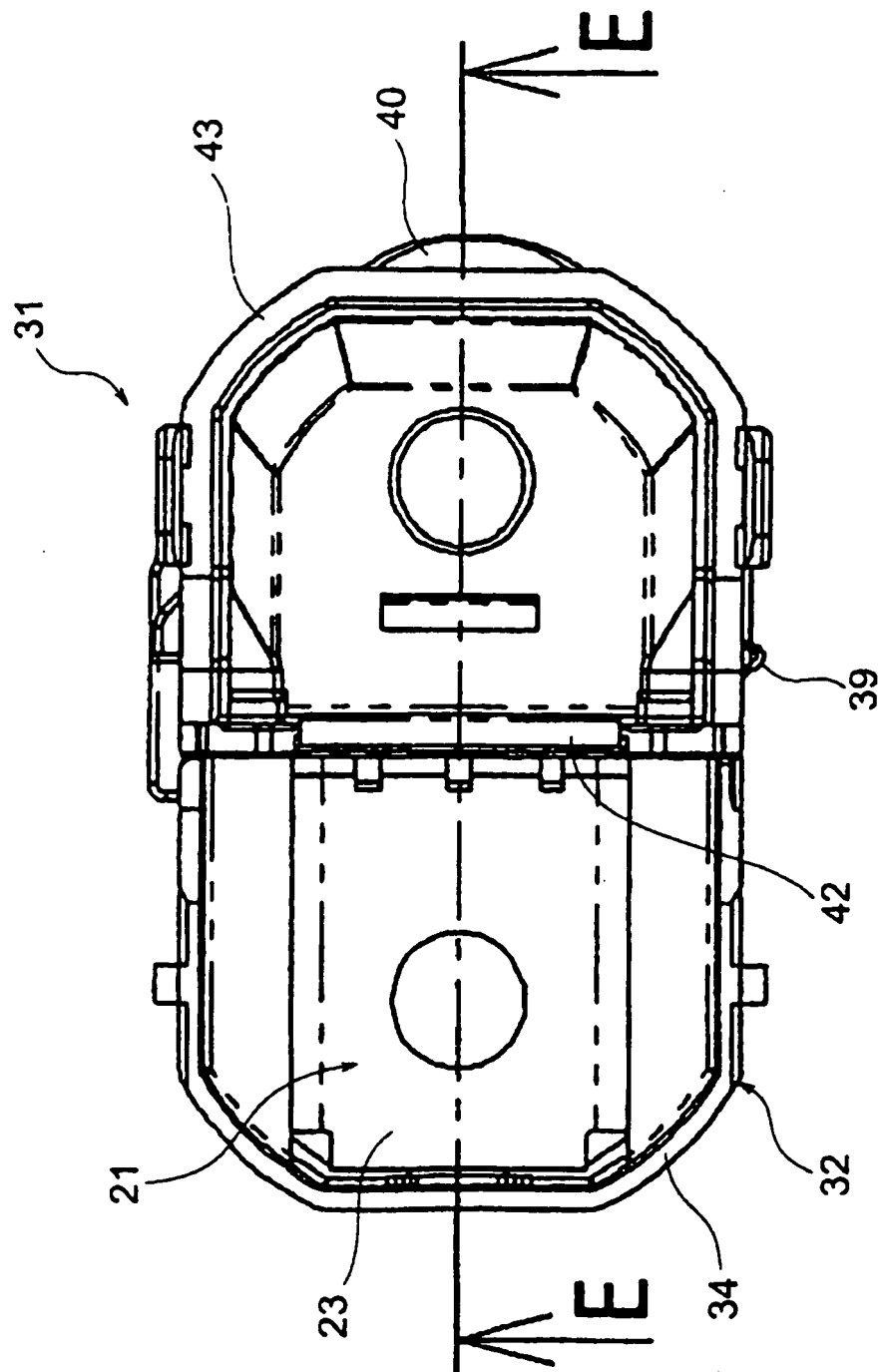


FIG. 5 (a)

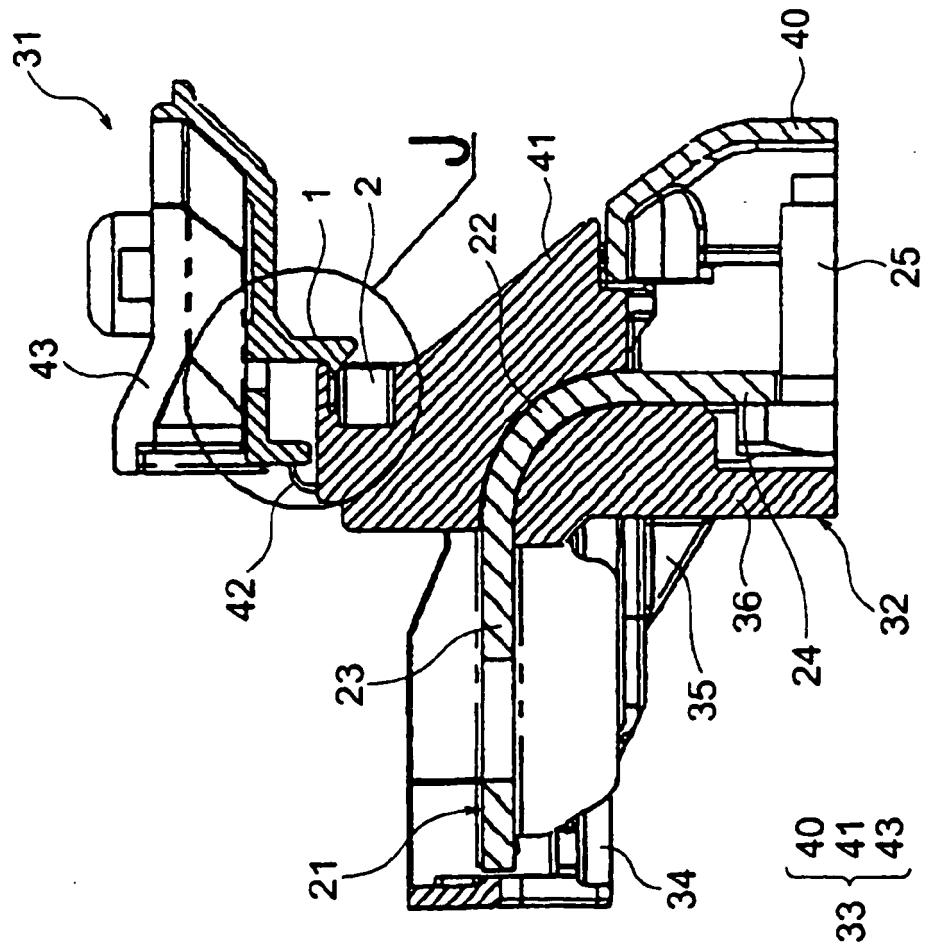


FIG. 5 (b)

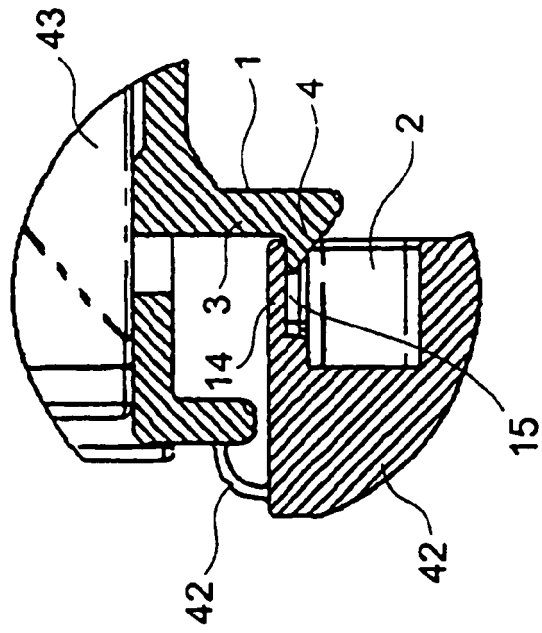


FIG. 6 (a)

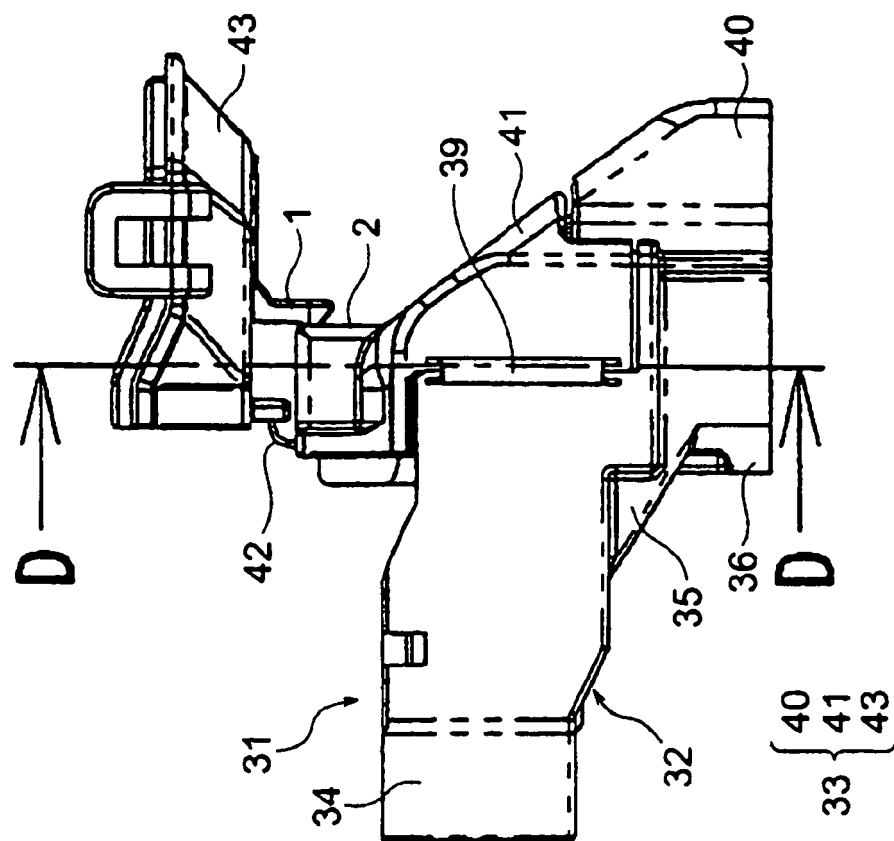


FIG. 6 (b)

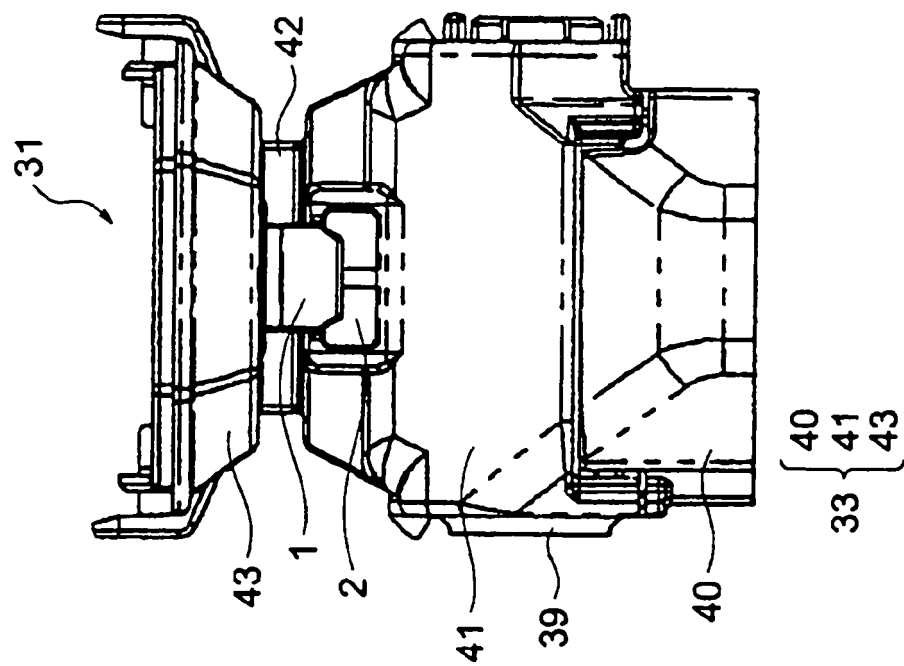


FIG. 7 (a)

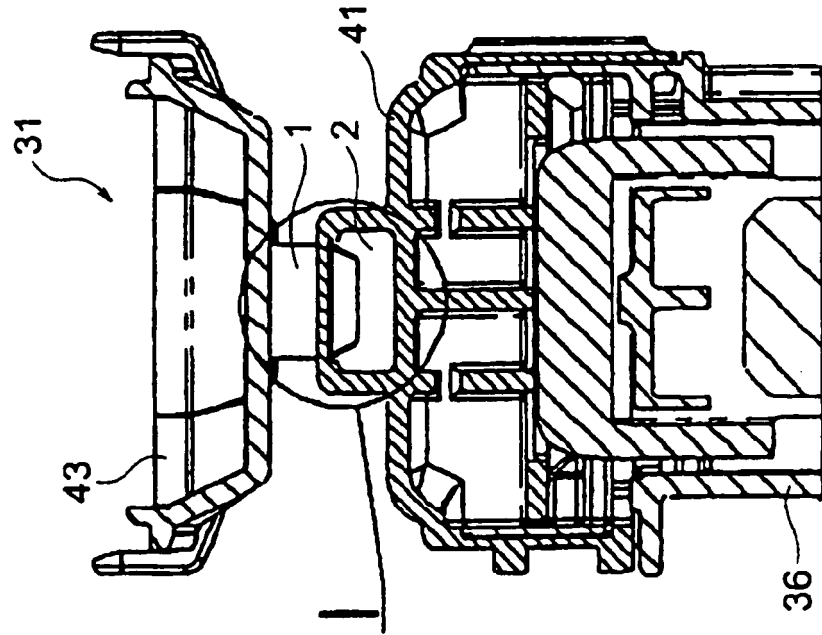


FIG. 7 (b)

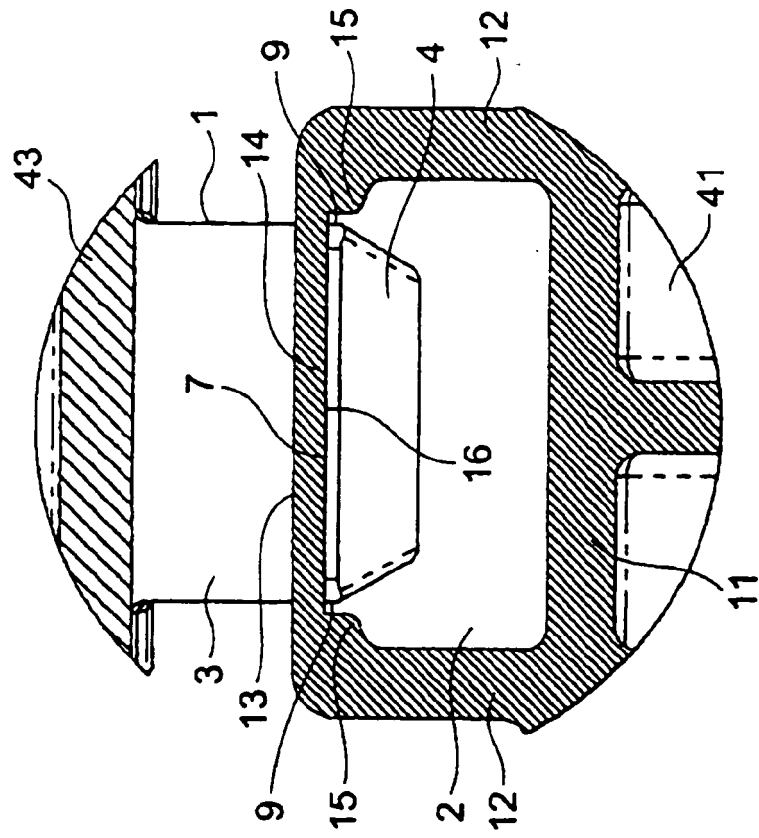
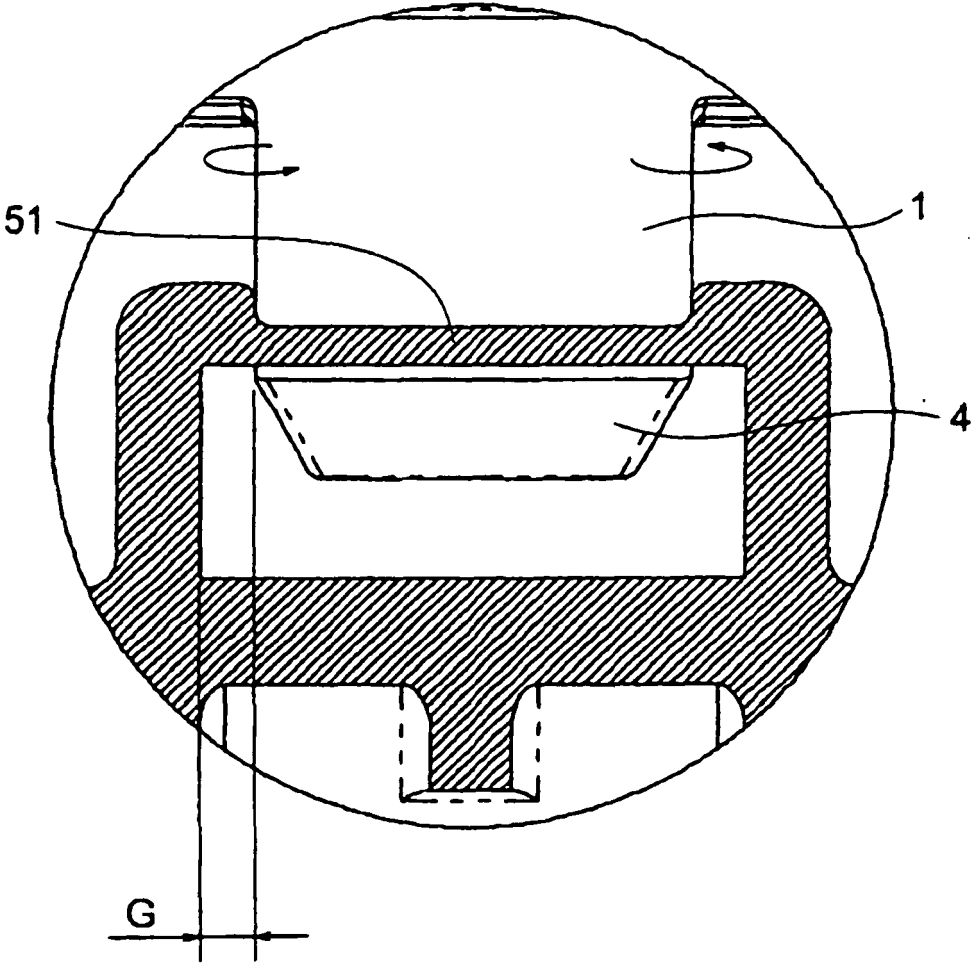


FIG. 8



**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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