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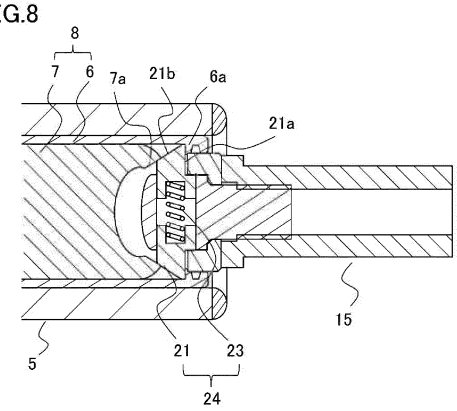
(54) GAS-INSULATED SWITCHING DEVICE

(57) Provided is a gas insulated switchgear that enables adjustment of the interruption speed while stabilizing the position where a fixed electrode is separated from a movable electrode. The gas insulated switchgear includes: a movable electrode (8) having a movable electrode rod (6) and a movable-side shaft rod (7); a fixed electrode (14) provided coaxially with the movable electrode; a driving portion which linearly drives the movable electrode; and an opening mechanism which separates the fixed electrode from the movable electrode. The movable electrode has a taper portion (7a) and a protrusion (6a) at a part to contact with the fixed electrode. The fixed electrode includes a latch portion (24) composed of a claw (20) having an engagement portion (20a) to be engaged with the protrusion and a slope portion (20b) to contact with the taper portion, and a contact-pressure spring (22) applying a restoring force to the claw.

FIG.8



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a gas insulated switchgear.

BACKGROUND ART

[0002] A gas insulated switchgear includes a switch for interrupting current. The switch includes a movable-side terminal having a movable electrode, a fixed-side terminal provided so as to be opposed to the movable-side terminal, and a driving portion for linearly driving the movable electrode toward the fixed-side terminal. The fixed-side terminal has a fixed electrode, a latch portion for engaging the fixed electrode with the movable electrode, and an opening mechanism for separating the fixed electrode from the movable electrode. The opening mechanism has an opening spring for driving the fixed electrode in a direction to separate from the movable electrode.

[0003] At the time of closing the switch, the driving portion drives the movable electrode in a direction to approach the fixed electrode, so as to engage the movable electrode and the fixed electrode with each other. At the time of opening the switch, the driving portion drives the movable electrode in a direction away from the fixed electrode. At this time, the fixed electrode is pulled together with the movable electrode, whereby the opening spring of the opening mechanism is contracted. When the fixed electrode is pulled to a predetermined position, engagement of the latch portion is released by a restoring force of the opening spring. Thus, the fixed electrode is separated from the movable electrode, whereby the switch is opened.

[0004] A conventional latch portion of a switch has a plate spring structure of which one end is fixed and another end has a claw portion (see, for example, Patent Document 1).

CITATION LIST

PATENT DOCUMENT

[0005] Patent Document 1: Japanese Laid-Open Patent Publication No. 2010-27479

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006] In the conventional latch portion, the claw portion needs to have both a function of keeping engagement between the movable electrode and the fixed electrode against a spring load of the opening spring, and a function of releasing the engagement in accordance with the position of the fixed electrode. Therefore, because of axial misalignment between the movable electrode and the fixed electrode, change in a frictional force at the claw portion and a part engaged with the claw portion, and the like, the position where the fixed electrode is separated from the movable electrode is not stabilized, and since an engagement retaining force is weak, an opening spring having a great spring load cannot be applied, and thus the interruption speed cannot be increased.

[0007] The present disclosure has been made to solve the above problem, and an object of the present disclosure is to provide a gas insulated switchgear having a switch that enables adjustment of the interruption speed while stabilizing the position where the fixed electrode is separated from the movable electrode.

SOLUTION TO THE PROBLEMS

[0008] A gas insulated switchgear according to the present disclosure includes: a movable electrode; a fixed electrode provided on a same axis as the movable electrode; a driving portion which linearly drives the movable electrode in a direction of the axis so that the movable electrode contacts with/separates from the fixed electrode; and an opening mechanism which separates the fixed electrode from the movable electrode. The movable electrode has a taper portion having a recessed surface toward the axis, at a part to contact with the fixed electrode, and has a protrusion protruding toward the axis, at an outer circumferential part of the taper portion. The fixed electrode includes a latch portion composed of a claw having an engagement portion to be engaged with the protrusion and a slope portion to contact with the taper portion, and a contact-pressure spring applying a restoring force to the claw in a direction crossing the axis.

EFFECT OF THE INVENTION

[0009] In the gas insulated switchgear according to the present disclosure, the fixed electrode includes the latch portion composed of the claw having the engagement portion to be engaged with the protrusion and the slope portion to contact with the taper portion, and the contact-pressure spring applying the restoring force to the claw in the direction crossing the axis. Thus, it is possible to adjust the interruption speed while stabilizing the position where the fixed electrode is separated from the movable electrode.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

[FIG. 1] FIG. 1 is a sectional view of a gas insulated switchgear according to embodiment 1.
[FIG. 2] FIG. 2 is a sectional view of a fixed electrode according to embodiment 1.
[FIG. 3] FIG. 3 is a plan view of the fixed electrode

according to embodiment 1.

[FIG. 4] FIG. 4 is a plan view of the fixed electrode according to embodiment 1.

[FIG. 5] FIG. 5 is a sectional view of the gas insulated switchgear according to embodiment 1.

[FIG. 6] FIG. 6 is an enlarged sectional view of a switch according to embodiment 1.

[FIG. 7] FIG. 7 is a sectional view of the gas insulated switchgear according to embodiment 1.

[FIG. 8] FIG. 8 is an enlarged sectional view of the switch according to embodiment 1.

[FIG. 9] FIG. 9 is an enlarged sectional view of the switch according to embodiment 1.

[FIG. 10] FIG. 10 is a sectional view of a fixed electrode according to embodiment 2.

DESCRIPTION OF EMBODIMENTS

[0011] Hereinafter, a gas insulated switchgear according to embodiments for carrying out the present disclosure will be described in detail with reference to the drawings. In the drawings, the same reference characters denote the same or corresponding parts.

Embodiment 1

[0012] FIG. 1 is a sectional view of a switch of a gas insulated switchgear according to embodiment 1. A switch 1 of the gas insulated switchgear shown in FIG. 1 is in an opened state. The switch 1 includes a flange 2, a fixed-side terminal 4 fixed to an insulation holder 3, and a movable-side terminal 5. A cylindrical movable electrode rod 6 having a threaded inner circumferential surface and a columnar movable-side shaft rod 7 for linearly driving the movable electrode rod 6, are provided inside the movable-side terminal 5. The movable electrode rod 6 and the movable-side shaft rod 7 are provided on the same axis, and the movable electrode rod 6 and the movable-side shaft rod 7 compose a movable electrode 8. The outer circumferential surface of the movable-side shaft rod 7 is threaded for linearly driving the movable electrode rod 6. An insulation rod 9 is connected to one end of the movable-side shaft rod 7. The insulation rod 9 is connected to a driving portion 10. A conductive spring component (not shown) is provided between the movable-side terminal 5 and the movable electrode rod 6. Hereinafter, the longitudinal direction of the movable electrode rod 6 and the movable-side shaft rod 7 provided on the same axis is referred to as an axial direction.

[0013] The fixed-side terminal 4 includes a base conductor 11, a cylindrical conductor 12 connected to the base conductor, a piston 13 provided inside the cylindrical conductor 12, a cylinder 14 provided between the cylindrical conductor 12 and the piston 13, a fixed electrode 15 connected to an end of the cylinder 14, and an opening spring 16 provided around the outer circumference of the cylinder 14. The piston 13, the cylinder 14, and the opening spring 16 compose an opening mechanism. The fixed electrode 15 is provided on the same axis as the movable electrode. An electric field relaxing shield 17 is provided at an outer circumferential part of the fixed electrode 15. The electric field relaxing shield 17 is drawn out toward the movable-side terminal 5 together with the fixed electrode 15 when the fixed electrode 15 is pulled toward the movable-side terminal 5. An electrode contact-pressure spring 18 is provided at an outer circumferential part of the fixed electrode 15, so as to keep contact between the movable electrode rod 6 and the fixed electrode 15 when the movable electrode rod 6 and the fixed electrode 15 are conductively in contact with each other.

[0014] FIG. 2 is a sectional view of the fixed electrode 15. FIG. 3 is a plan view of the fixed electrode 15 as seen from A side in FIG. 2, and FIG. 4 is a plan view of the fixed electrode 15 as seen from B side in FIG. 2. The fixed electrode 15 includes a connection rod 19 connected to the cylinder 14, a fixed-side shaft rod 20, two claws 21 radially formed in directions crossing the axial direction of the fixed-side shaft rod 20, a stopper 22 restricting movement of the claws 21 in the axial direction and the radial direction, and a contact-pressure spring 23 pushing out the claws 21 in the outer circumferential direction. The two claws 21 are provided at positions opposed to each other with respect to the axis. The two claws 21 and the contact-pressure spring 23 compose a latch portion 24. The claws 21 are pushed out in the outer circumferential direction by the restoring force of the contact-pressure spring 23. The outer periphery of each claw 21 has a circular shape, an elliptic shape, a quadrangular shape, or a shape formed by combination thereof. The claw 21 has an engagement portion 21a to be engaged with a protrusion formed at the movable electrode rod as described later, and a slope portion 21b to contact with a taper portion formed at the movable-side shaft rod. As shown in FIG. 2, the engagement portions 21a of the claws 21 have a shape protruding to the outer circumferential side. The slope portions 21b of the claws 21 have such a shape that the distal end tapers toward the movable electrode side. The clearance between the fixed-side shaft rod 20 and the claws 21 in the axial direction, i.e., the horizontal direction in FIG. 2, is set to be small so as to suppress wobbling of the latch portion 24.

[0015] Next, operation of the switch 1 of the gas insulated switchgear in the present embodiment will be described.

[0016] When the switch 1 in the opened state shown in FIG. 1 is to be closed, the driving portion 10 rotates the insulation rod 9, for example, clockwise. As the insulation rod 9 is rotated clockwise, the movable-side shaft rod 7 rotates about the axis. As the movable-side shaft rod 7 rotates about the axis, the movable electrode rod 6 is linearly driven rightward in FIG. 1 through meshing between the thread on the outer circumferential surface of the movable-side shaft rod 7 and the thread on the inner circumferential surface of the movable electrode rod 6.

[0017] FIG. 5 is a sectional view of the switch of the gas insulated switchgear according to the present embodiment, in a closed state. As shown in FIG. 5, in the switch 1 in a closed state, the distal end of the movable electrode rod 6 contacts with the fixed electrode 15. FIG. 6 is an enlarged sectional view of a specific part of the switch 1 in a closed state in the present embodiment. As shown in FIG. 6, a taper portion 7a having a recessed surface toward the axis is formed at the distal end of the movable-side shaft rod 7. A protrusion 6a protruding toward the axis is formed on the inner circumferential surface at the distal end of the movable electrode rod 6. In the switch 1 in a closed state, the engagement portion 21a of each claw 21 is engaged with the protrusion 6a, so that the fixed electrode 15 and the movable electrode 8 are electrically connected to each other.

[0018] When the switch 1 is to be opened from the closed state shown in FIG. 5, the driving portion 10 rotates the insulation rod 9 counterclockwise. As the insulation rod 9 is rotated counterclockwise, the movable-side shaft rod 7 rotates about the axis. As the movable-side shaft rod 7 rotates about the axis, the movable electrode rod 6 is linearly driven leftward in FIG. 5 through meshing between the thread on the outer circumferential surface of the movable-side shaft rod 7 and the thread on the inner circumferential surface of the movable electrode rod 6.

[0019] FIG. 7 is a sectional view of the switch of the gas insulated switchgear according to the present embodiment, just before the switch is opened. As shown in FIG. 7, the fixed electrode 15 pulled by the movable electrode rod 6 linearly driven leftward enters the inside of the movable-side terminal 5, and the distal end of the fixed electrode 15 contacts with the distal end of the movable-side shaft rod 7. FIG. 8 is an enlarged sectional view of a specific part where the movable-side shaft rod 7 and the fixed electrode 15 contact with each other. As shown in FIG. 8, when the fixed electrode 15 enters the inside of the movable-side terminal 5, the slope portion 21b of each claw 21 is pressed to the taper portion 7a at the distal end of the movable-side shaft rod 7. At this time, the engagement portion 21a of the claw 21 is engaged with the protrusion 6a of the movable electrode rod 6. When the movable electrode rod 6 is further linearly driven leftward, the protrusion 6a moves leftward, so that the engagement portion 21a of each claw 21 also moves leftward. Along with this, the slope portions 21b of the claws 21 are compressed along the taper portions 7a. Thus, the claws 21 slide toward the axis while compressing the contact-pressure spring 23.

[0020] FIG. 9 is a sectional view of the switch of the gas insulated switchgear according to the present embodiment, just before the engagement between the engagement portion 21a of each claw 21 and the protrusion 6a of the movable electrode rod 6 is released. As shown in FIG. 9, when the slope portion 21b of each claw 21 is compressed along the taper portion 7a, the engagement portion 21a moves toward the inner circumferential side, so that the engagement between the engagement portion 21a and the protrusion 6a of the movable electrode rod 6 is released. When the engagement between each engagement portion 21a and the protrusion 6a is released, the fixed electrode 15 moves rightward by the restoring force of the opening spring 16 that has been compressed, so that the fixed electrode 15 is separated from the movable electrode 8. As a result, electric connection between the fixed electrode 15 and the movable electrode 8 is disconnected, so that the switch 1 comes into the opened state shown in FIG. 1.

[0021] In the gas insulated switchgear of the present embodiment, the latch portion of the switch includes the claw having the engagement portion to be engaged with the protrusion of the movable electrode and the slope portion to contact with the taper portion of the movable electrode rod, and the contact-pressure spring applying the restoring force to the claw in the direction crossing the axis. Thus, the function of keeping engagement between the fixed electrode and the movable electrode against the spring load of the opening spring can be borne by the engagement portion, and the function of releasing the engagement in accordance with the position of the fixed electrode can be borne by the slope portion. As a result, it is possible to stabilize the position where the fixed electrode is separated from the movable electrode, even if axial misalignment between the movable electrode and the fixed electrode, change in the frictional force at the protrusion of the movable electrode, or the like has occurred.

[0022] For example, in the latch portion, the force for keeping engagement between the fixed electrode and the movable electrode against the spring load of the opening spring can be adjusted by, for example, the contact angle and the contact area between the engagement portion of the claw and the protrusion of the movable electrode rod. Meanwhile, in the latch portion, the position of the fixed electrode when the engagement is released can be adjusted by, for example, the contact angle and the contact area between the slope portion of the claw and the taper portion of the movable-side shaft rod, and the spring load of the contact-pressure spring. Thus, in the latch portion, the part bearing the function of keeping engagement between the fixed electrode and the movable electrode against the spring load of the opening spring and the part bearing the function of releasing the engagement in accordance with the position of the fixed electrode can be separated from each other, and therefore the respective functions can be adjusted without influencing each other function. Further, since the clearance between the fixed-side shaft rod 20 and the claw 21 in the axial direction is set to be small, it becomes possible to increase the load of the opening spring. Thus, the opening speed can be increased.

[0023] As described above, in the gas insulated switchgear of the present embodiment, the latch portion of the switch includes the claw having the engagement portion to be engaged with the protrusion of the movable elec-

trode and the slope portion to contact with the taper portion of the movable electrode rod, and the contact-pressure spring applying the restoring force to the claw in the direction crossing the axis. Thus, the gas insulated switchgear of the present embodiment makes it possible to adjust the interruption speed while stabilizing the position where the fixed electrode is separated from the movable electrode.

[0024] In the present embodiment, the latch portion has two claws. The latch portion may have three or more claws.

Embodiment 2

[0025] FIG. 10 is a sectional view of a fixed electrode of a switch of a gas insulated switchgear according to embodiment 2. The structure of the switch in the present embodiment is the same as the structure of the switch in embodiment 1. As shown in FIG. 10, the fixed electrode 15 according to the present embodiment includes two contact-pressure springs 23 pushing out the two claws 21 in the outer circumferential direction. The two contact-pressure springs 23 are respectively provided between the fixed-side shaft rod 20 and the two claws 21.

[0026] In the gas insulated switchgear configured as described above, as in embodiment 1, the function of keeping engagement between the fixed electrode and the movable electrode against the spring load of the opening spring can be borne by the engagement portion, and the function of releasing the engagement in accordance with the position of the fixed electrode can be borne by the slope portion. As a result, it is possible to adjust the interruption speed while stabilizing the position where the fixed electrode is separated from the movable electrode, even if axial misalignment between the movable electrode and the fixed electrode, change in the frictional force at the protrusion of the movable electrode, or the like has occurred. In addition, since the fixed electrode includes two contact-pressure springs 23 pushing out the two claws 21 in the outer circumferential direction, the two claws 21 can be operated independently of each other. As a result, it is possible to suppress variations in the contact pressures against the respective claws due to axial misalignment between the movable electrode and the fixed electrode, driving vibration, or the like.

[0027] Although the disclosure is described above in terms of various exemplary embodiments and implementations, it should be understood that the various features, aspects, and functionality described in one or more of the individual embodiments are not limited in their applicability to the particular embodiment with which they are described, but instead can be applied, alone or in various combinations to one or more of the embodiments of the disclosure.

[0028] It is therefore understood that numerous modifications which have not been exemplified can be devised without departing from the scope of the present disclosure. For example, at least one of the constituent components may be modified, added, or eliminated. At least one of the constituent components mentioned in at least one of the preferred embodiments may be selected and combined with the constituent components mentioned in another preferred embodiment.

DESCRIPTION OF THE REFERENCE CHARACTERS

[0029]

1	switch
2	flange
3	insulation holder
4	fixed-side terminal
5	movable-side terminal
6	movable electrode rod
6a	protrusion
7	movable-side shaft rod
7a	taper portion
8	movable electrode
9	insulation rod
10	driving portion
11	base conductor
12	cylindrical conductor
13	piston
14	cylinder
15	fixed electrode
16	opening spring
17	electric field relaxing shield
18	electrode contact-pressure spring
19	connection rod
20	fixed-side shaft rod
21	claw
21a	engagement portion
21b	slope portion
22	stopper
23	contact-pressure spring
24	latch portion

Claims

1. A gas insulated switchgear comprising:

a movable electrode;
a fixed electrode provided on a same axis as the movable electrode;
a driving portion which linearly drives the movable electrode in a direction of the axis so that the movable electrode contacts with/separates from the fixed electrode; and
an opening mechanism which separates the fixed electrode from the movable electrode, wherein
the movable electrode has a taper portion having a recessed surface toward the axis, at a part to contact with the fixed electrode, and has a protrusion protruding toward the axis, at an outer

circumferential part of the taper portion, and
the fixed electrode includes a latch portion composed of

a claw having an engagement portion to be engaged with the protrusion and a slope portion to contact with the taper portion, and a contact-pressure spring applying a restoring force to the claw in a direction crossing the axis.

2. The gas insulated switchgear according to claim 1, wherein
the latch portion has a plurality of the claws, and has a plurality of the contact-pressure springs respectively applying the restoring forces to the plurality of claws.

FIG.1

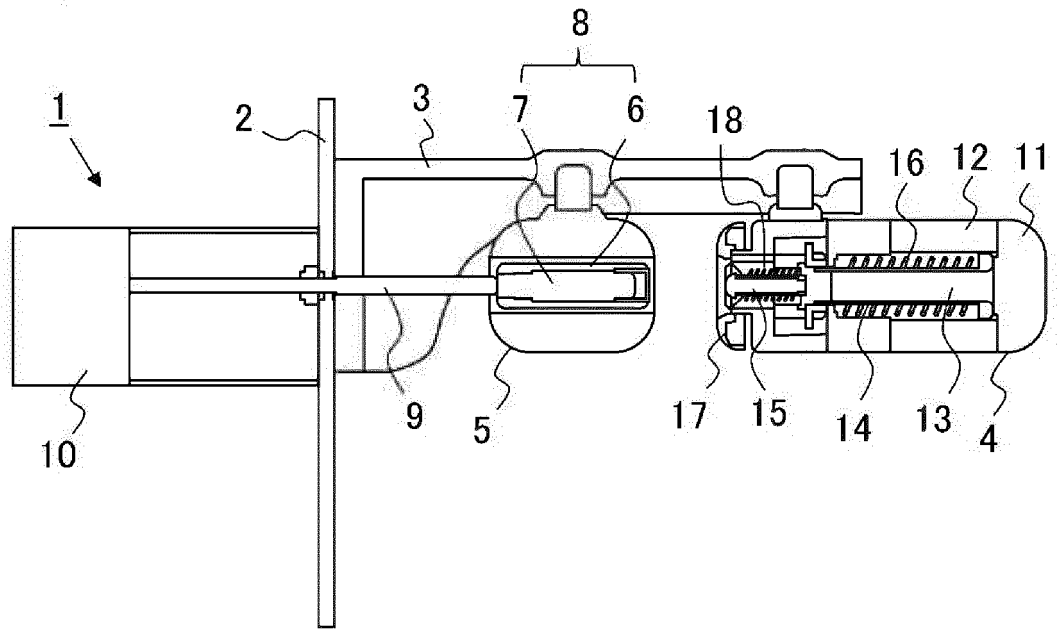


FIG.2

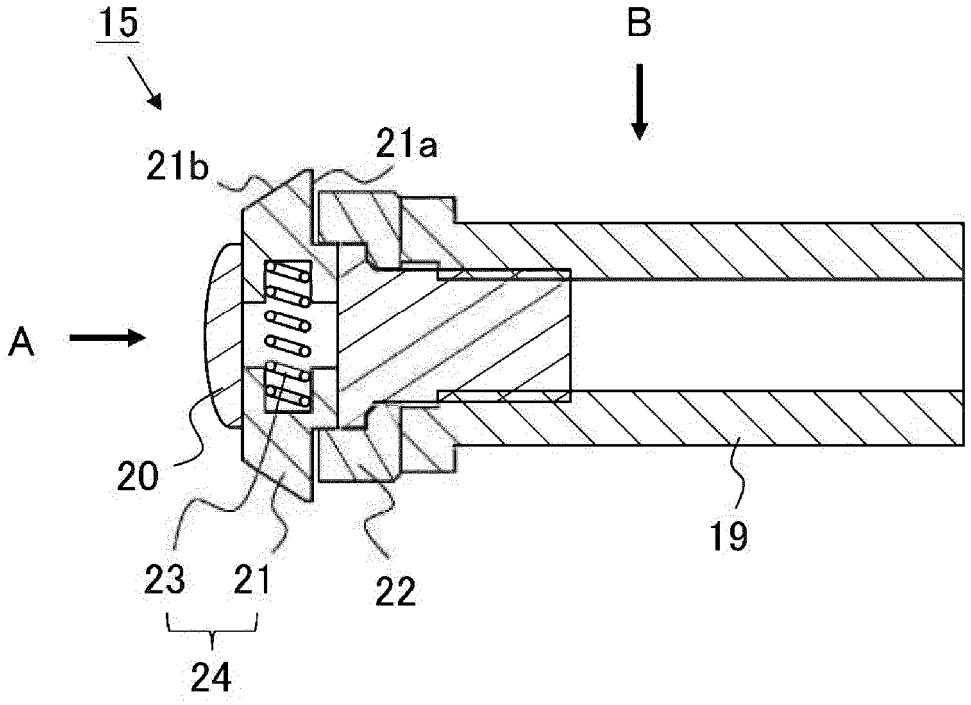


FIG.3

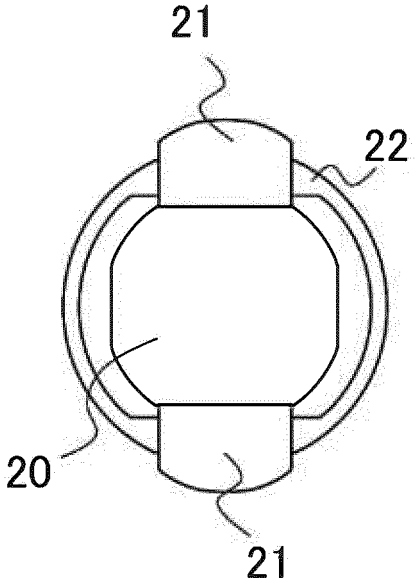


FIG.4

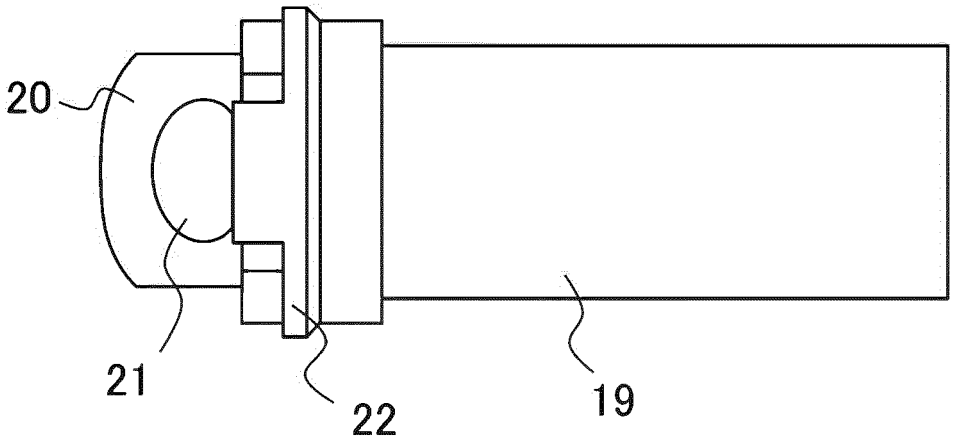


FIG.5

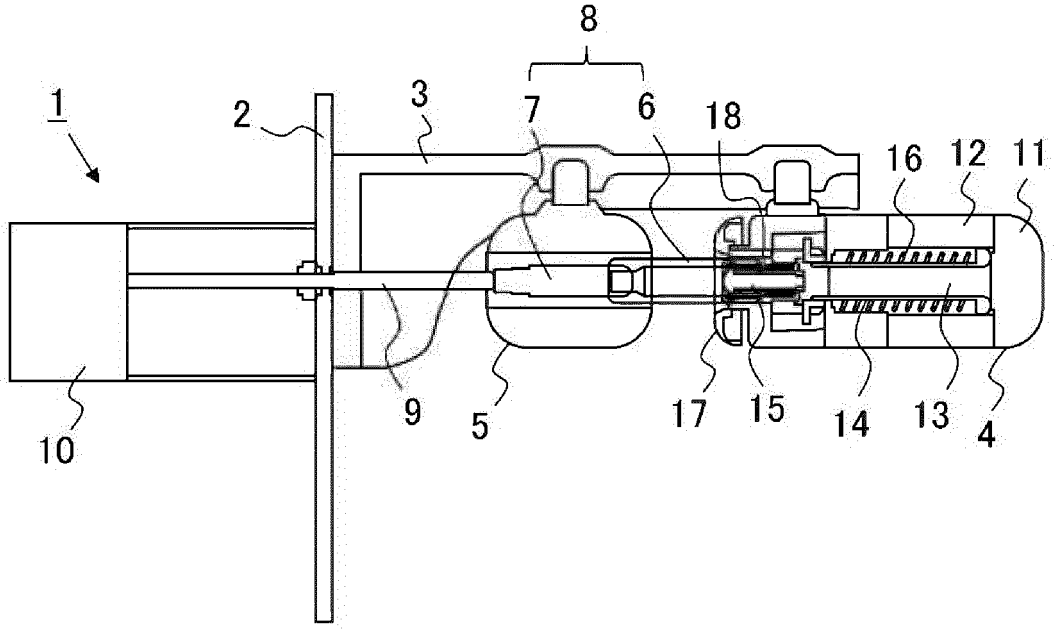


FIG.6

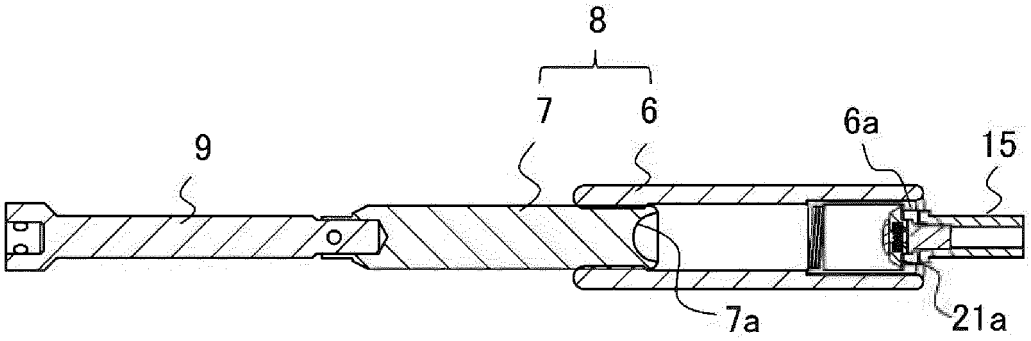


FIG.7

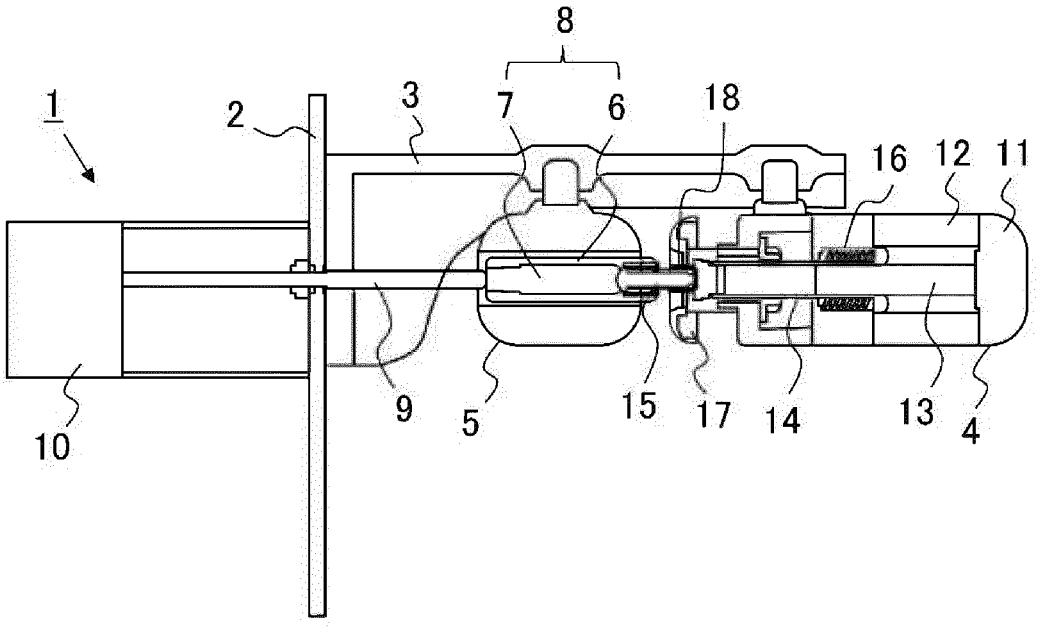


FIG.8

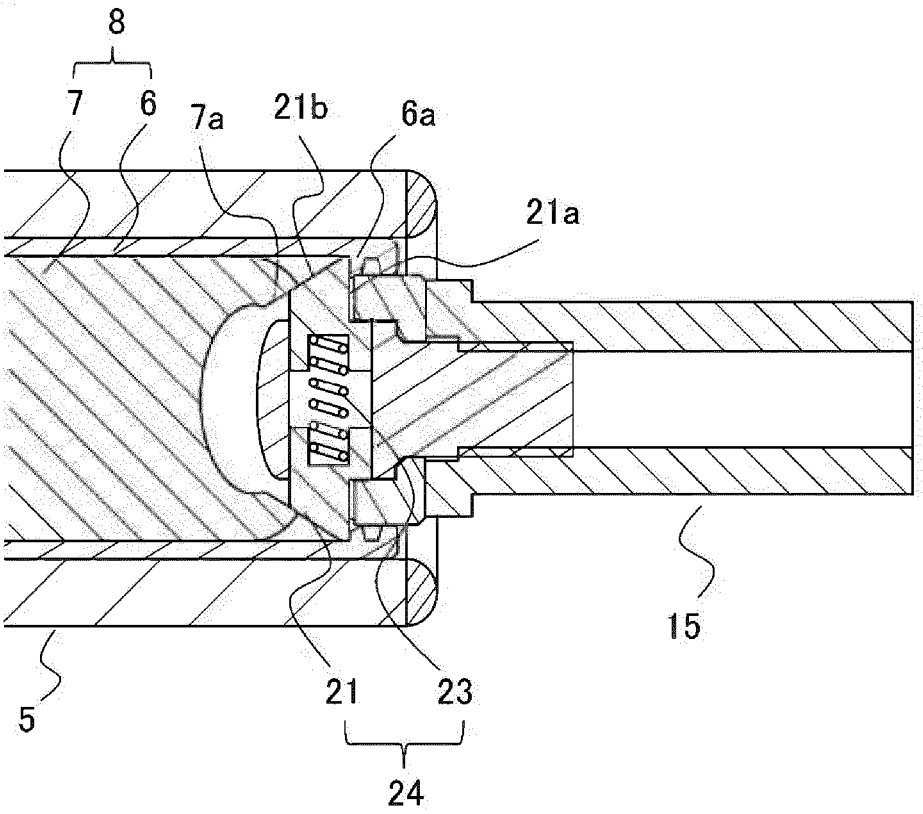


FIG.9

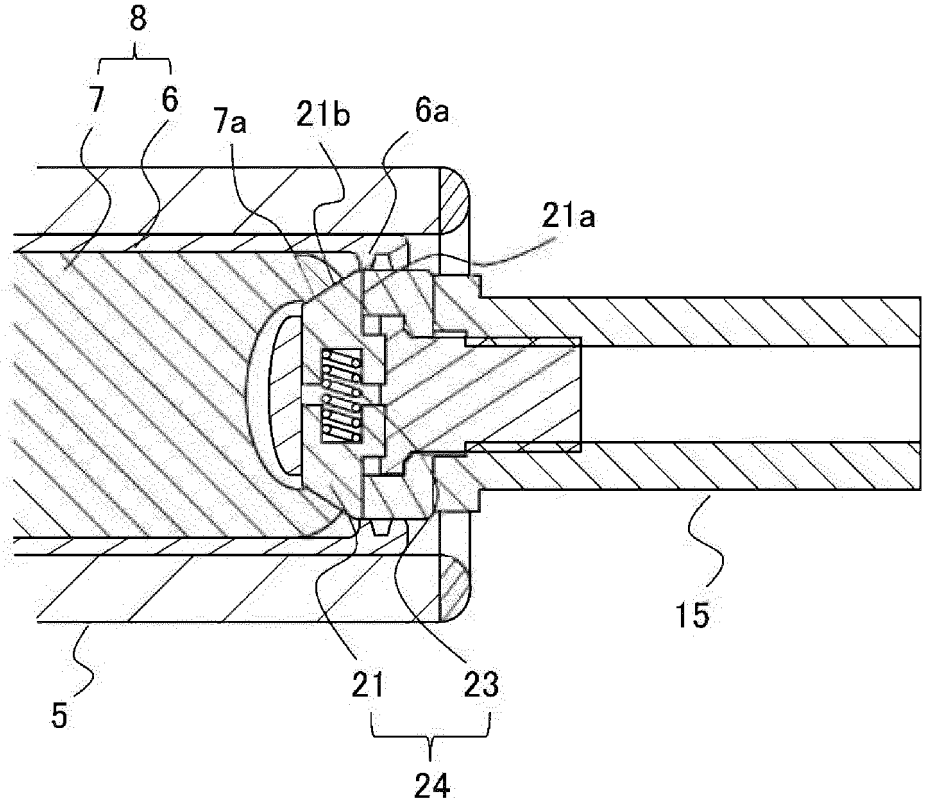
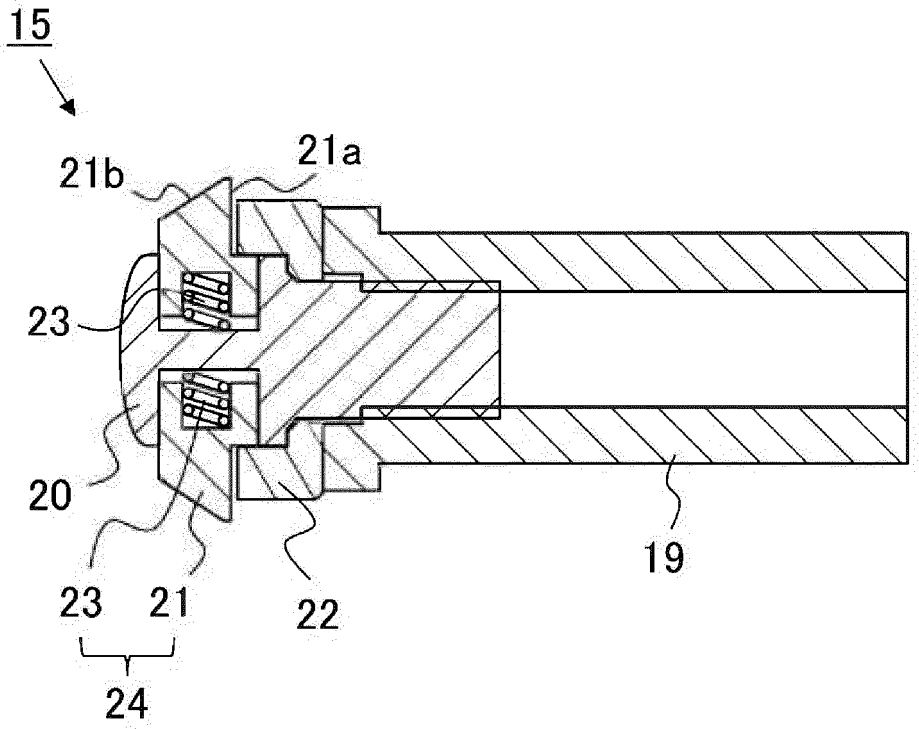


FIG.10



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/000291

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. H02B13/035(2006.01)i
FI: H02B13/035301H

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. H02B13/035

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-027479 A (MITSUBISHI ELECTRIC CORPORATION) 04 February 2010 (2010-02-04), paragraphs [0008]-[0035], fig. 1-13	1, 2
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 173302/1977 (Laid-open No. 092162/1978) (HITACHI, LTD.) 27 July 1978 (1978-07-27), specification, pages 2-13, fig. 1-5	1, 2
A	JP 8-306278 A (SUMITOMO WIRING SYSTEMS, LTD.) 22 November 1996 (1996-11-22), paragraphs [0001]-[0027], fig. 1-11	1, 2

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 March 2021	16 March 2021

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/000291

JP 2010-027479 A	04 February 2010	(Family: none)	
JP 53-092162 U1	27 July 1978	(Family: none)	
JP 8-306278 A	22 November 1996	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010027479 A **[0005]**