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Sakuda et al.

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(54) **STEERING APPARATUS**

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(30) **Foreign Application Priority Data**

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B62D 1/184 (2006.01)

(52) **U.S. Cl.**
CPC ***B62D 1/195*** (2013.01); ***B62D 1/184*** (2013.01); ***B62D 1/192*** (2013.01)

(58) **Field of Classification Search**
CPC B62D 1/195; B62D 1/192; B62D 1/184
See application file for complete search history.

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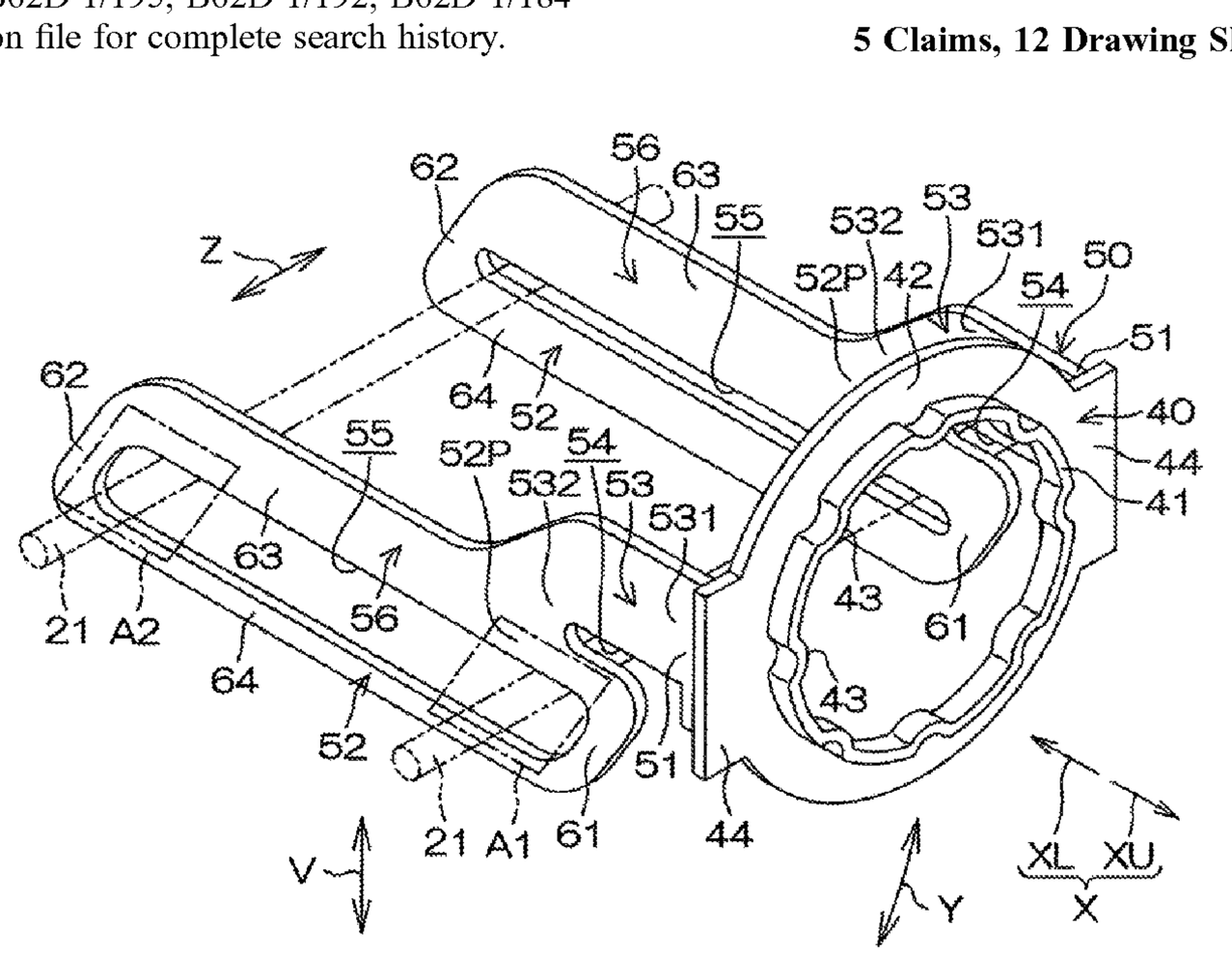
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Primary Examiner — Darlene P Condra
(74) *Attorney, Agent, or Firm* — Oliff PLC

(57) **ABSTRACT**

A first sliding member is held by an upper jacket. A second sliding member includes a fixed portion fixed to the first sliding member, and an extension portion that extends in a column axis direction and that has a coupled portion coupled to the fixed portion at a predetermined location in the column axis direction. The second sliding member being clamped by the clamping mechanism slides relative to a supporting member and a lower jacket during a secondary impact. The second sliding member includes a slit that reduces coupling stiffness between the fixed portion and the coupled portion of the extension portion so as to facilitate, in a clamping state of the clamping mechanism, deflection of the coupled portion of the extension portion relative to the fixed portion in a lateral direction as seen from the column axis direction.

5 Claims, 12 Drawing Sheets



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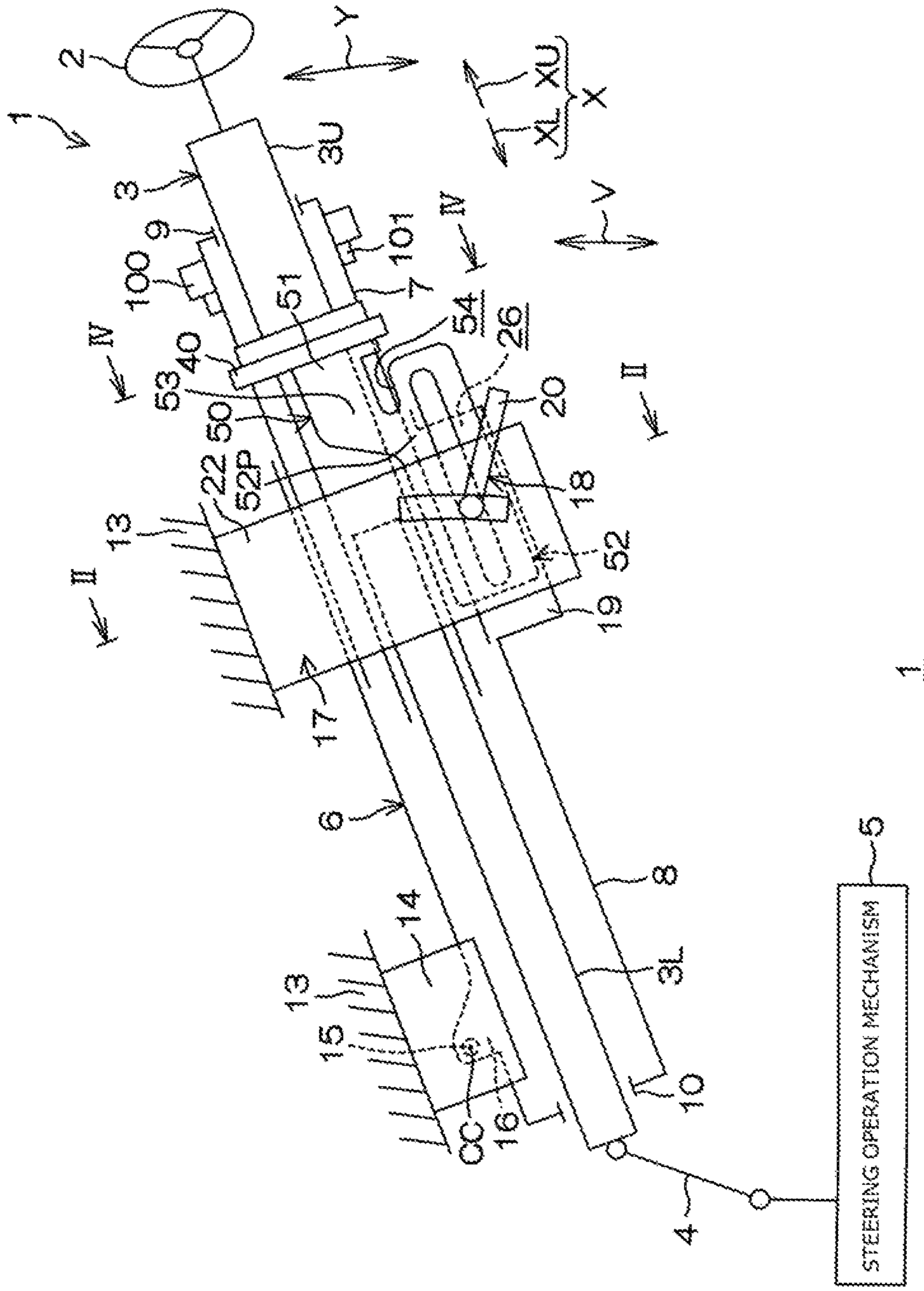

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10C
10S
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STEERING OPERATION MECHANISM

FIG.1

FIG.2

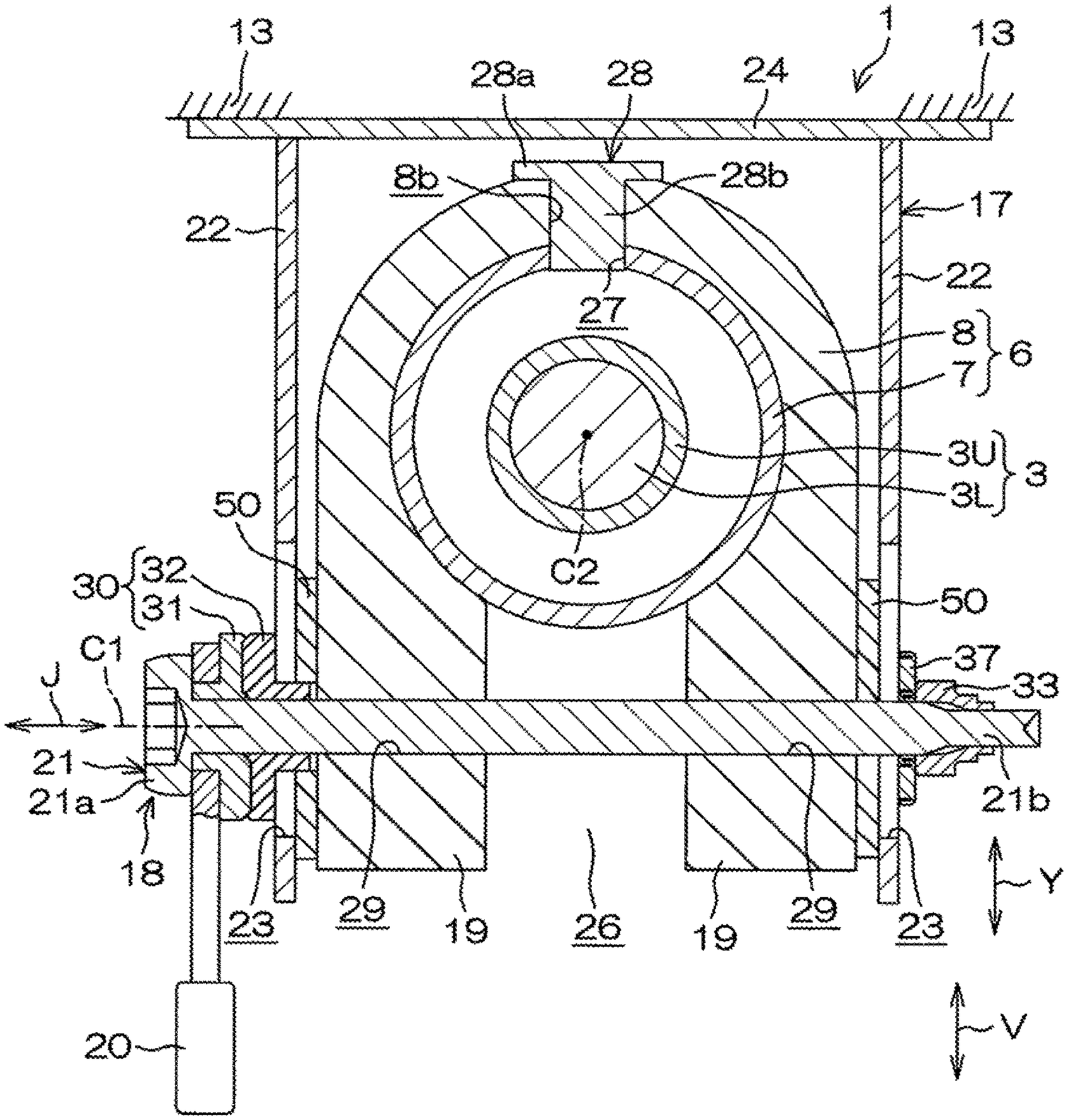

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28a
28
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6
3U
3L
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FIG.3

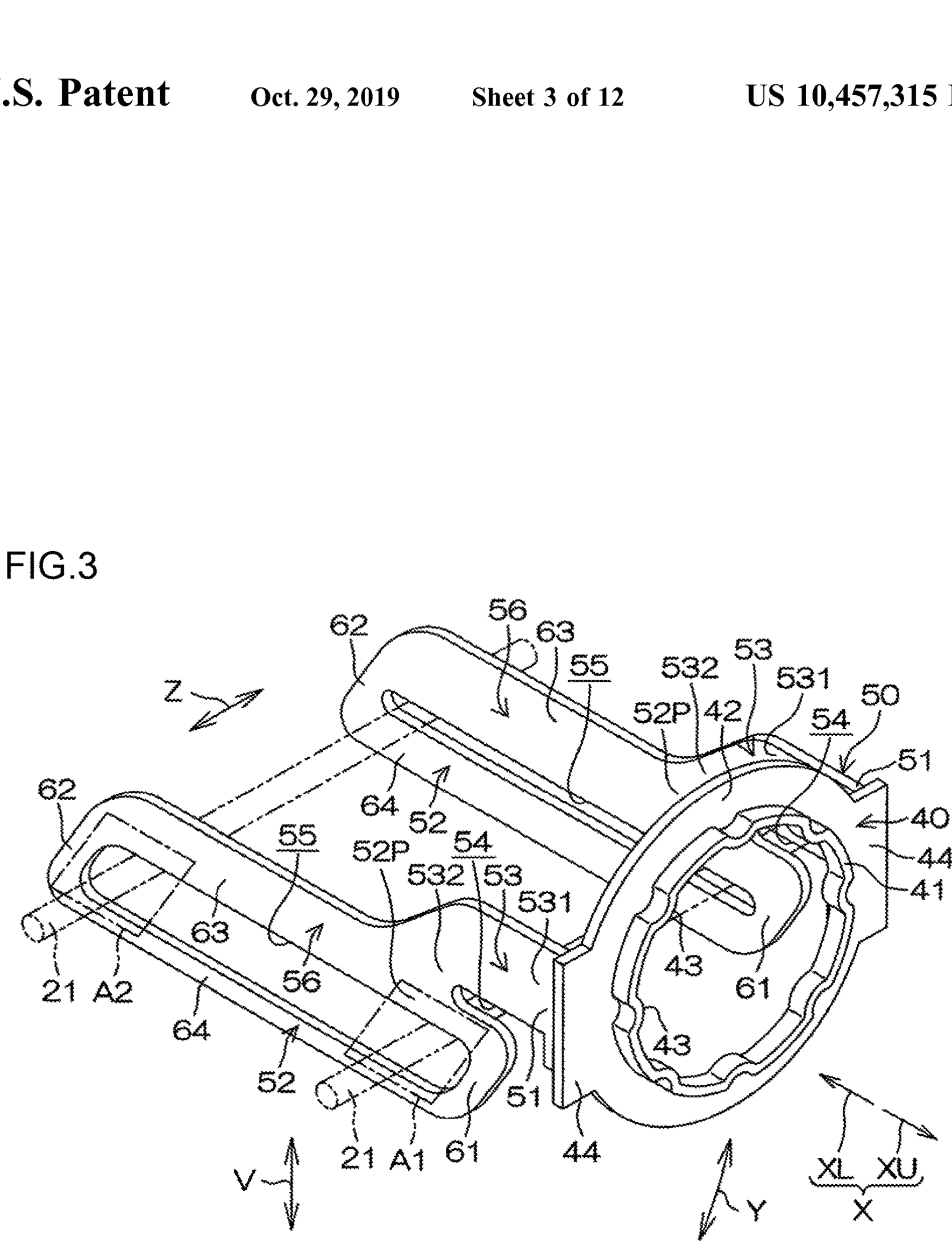

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FIG.4A

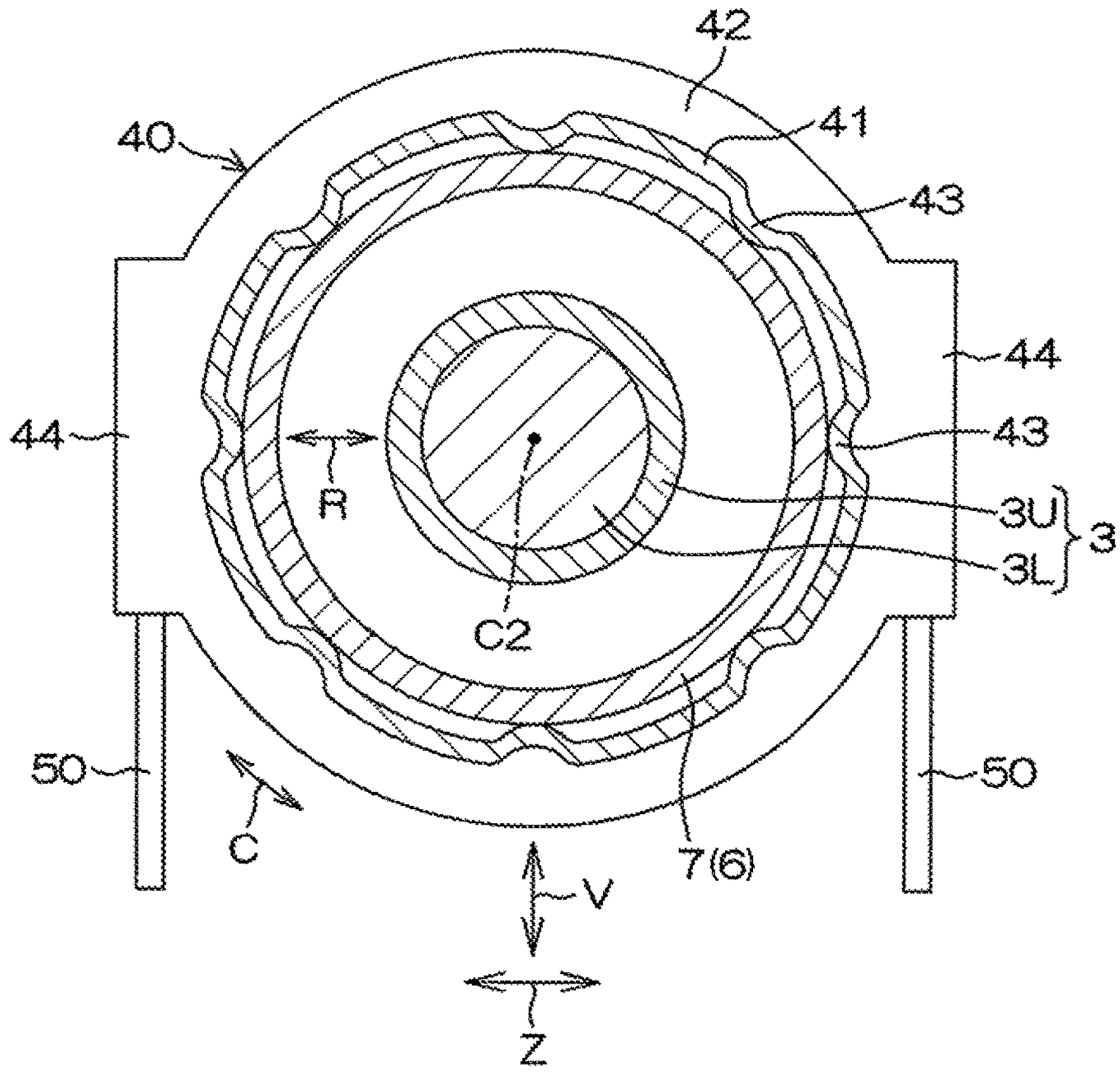
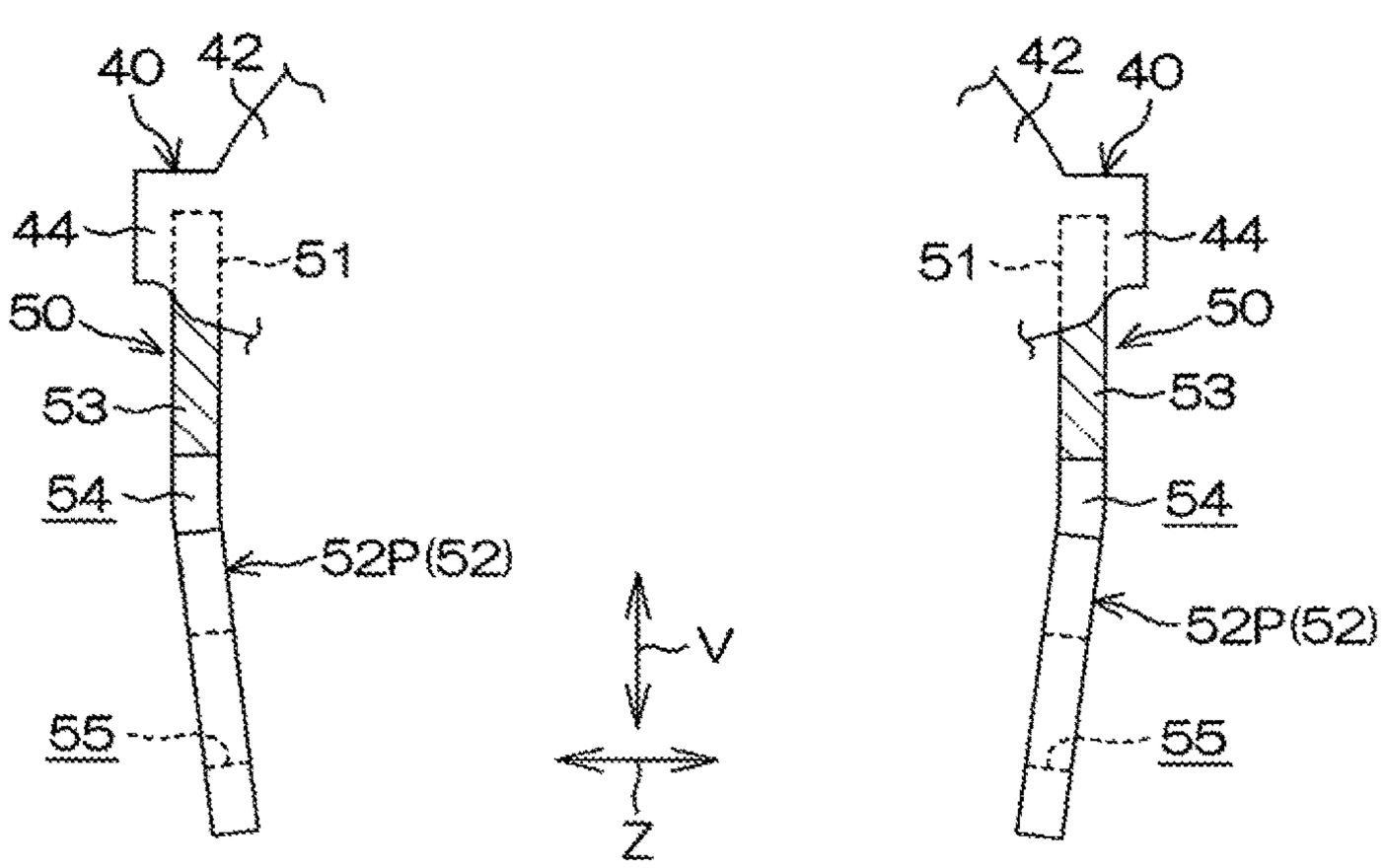

42
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R
3U
3L
3
C2
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C
7(6)
V
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FIG.4B


40
42
44
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52P(52)
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V
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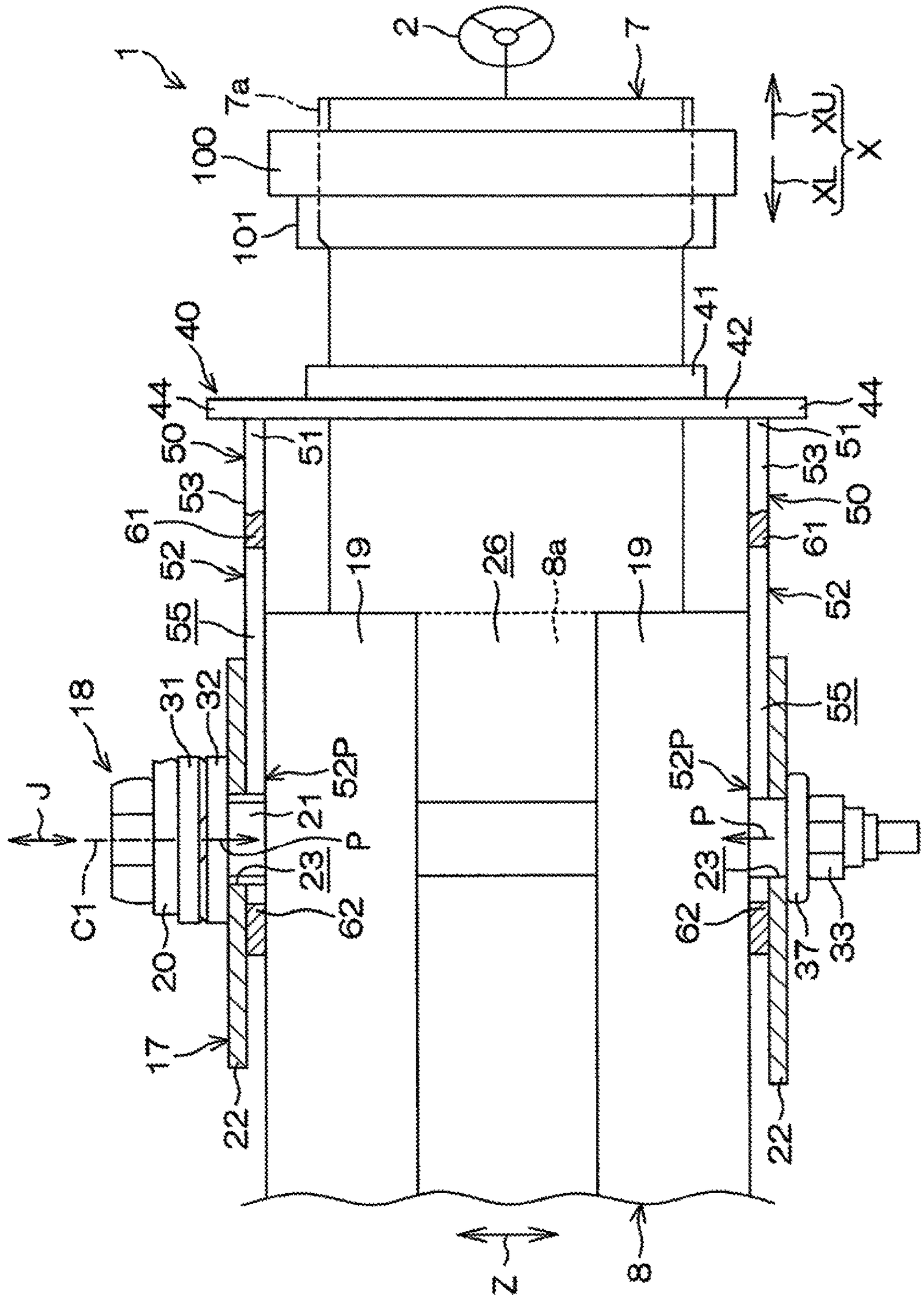

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FIG.5

FIG.6A

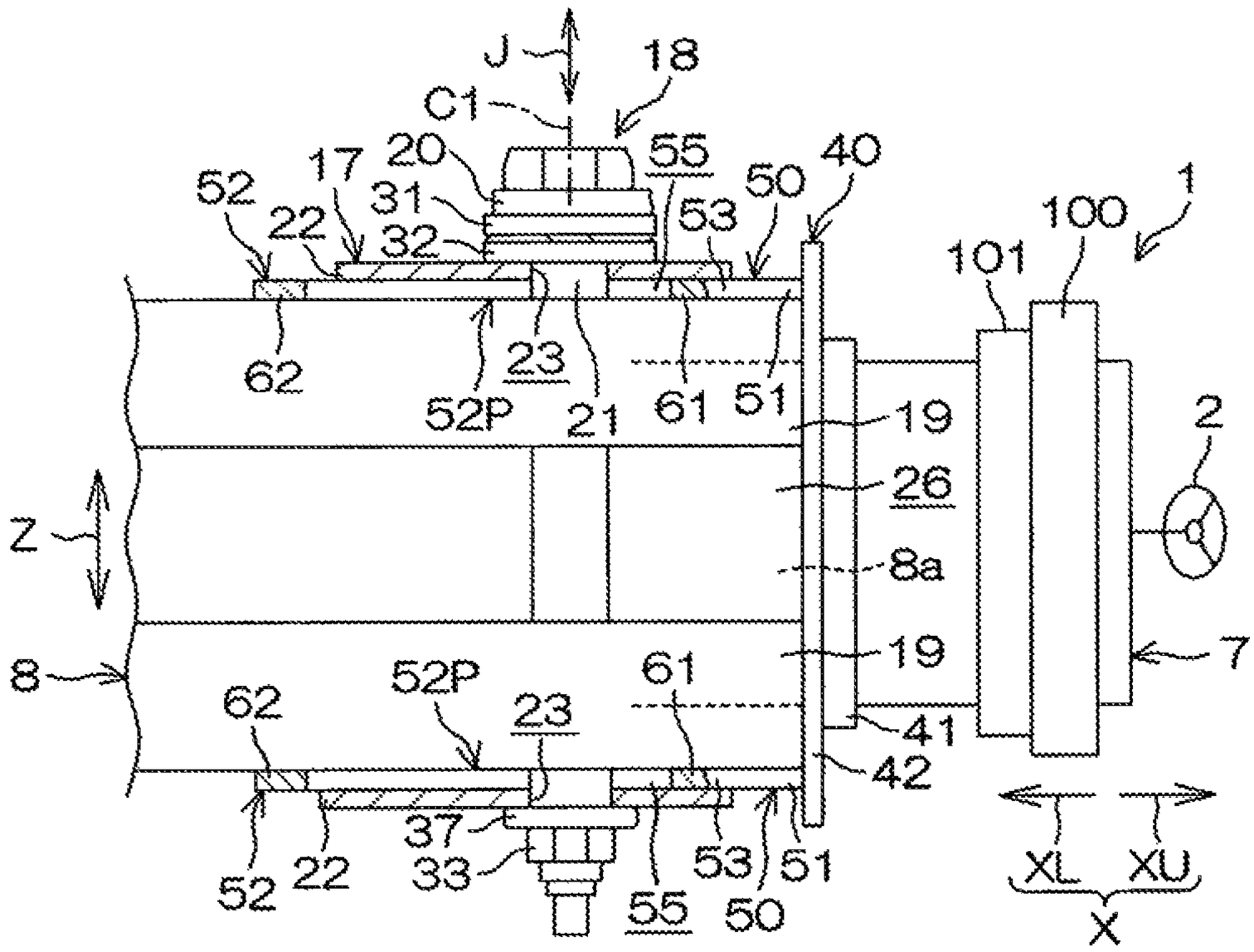

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FIG.6B

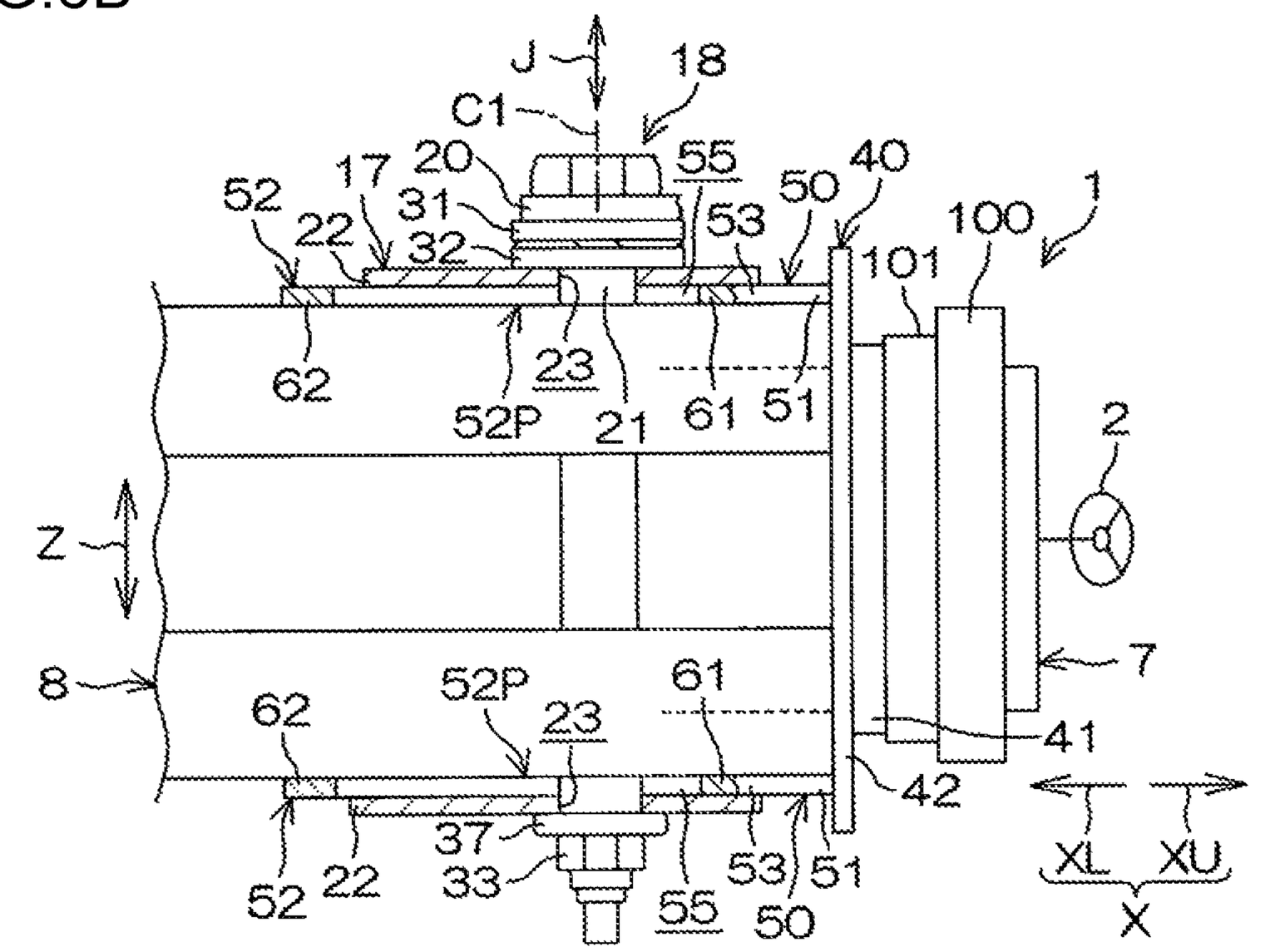

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FIG.7

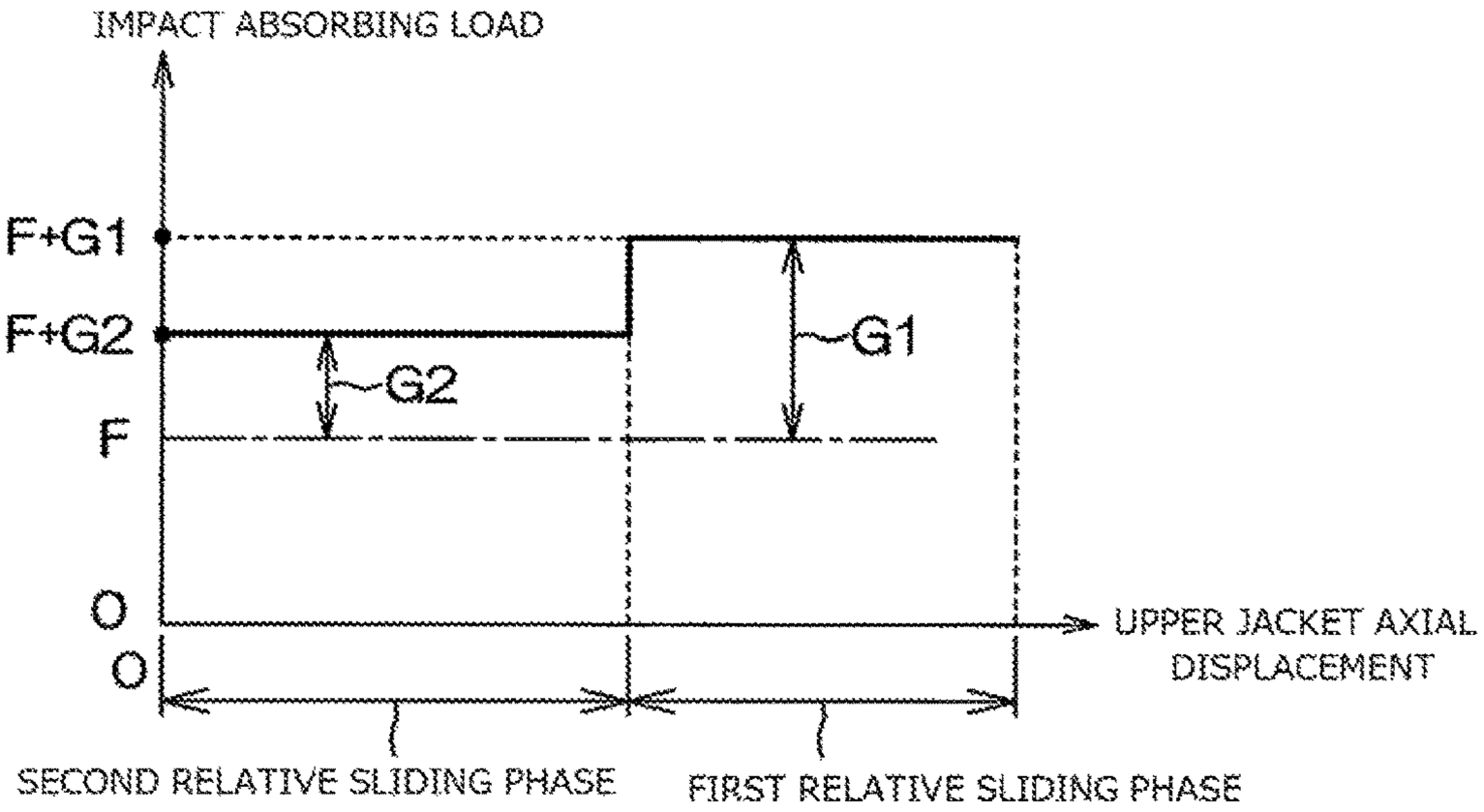

IMPACT ABSORBING LOAD
F+G1
F+G2
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UPPER JACKET AXIAL DISPLACEMENT
SECOND RELATIVE SLIDING PHASE
FIRST RELATIVE SLIDING PHASE

FIG.8

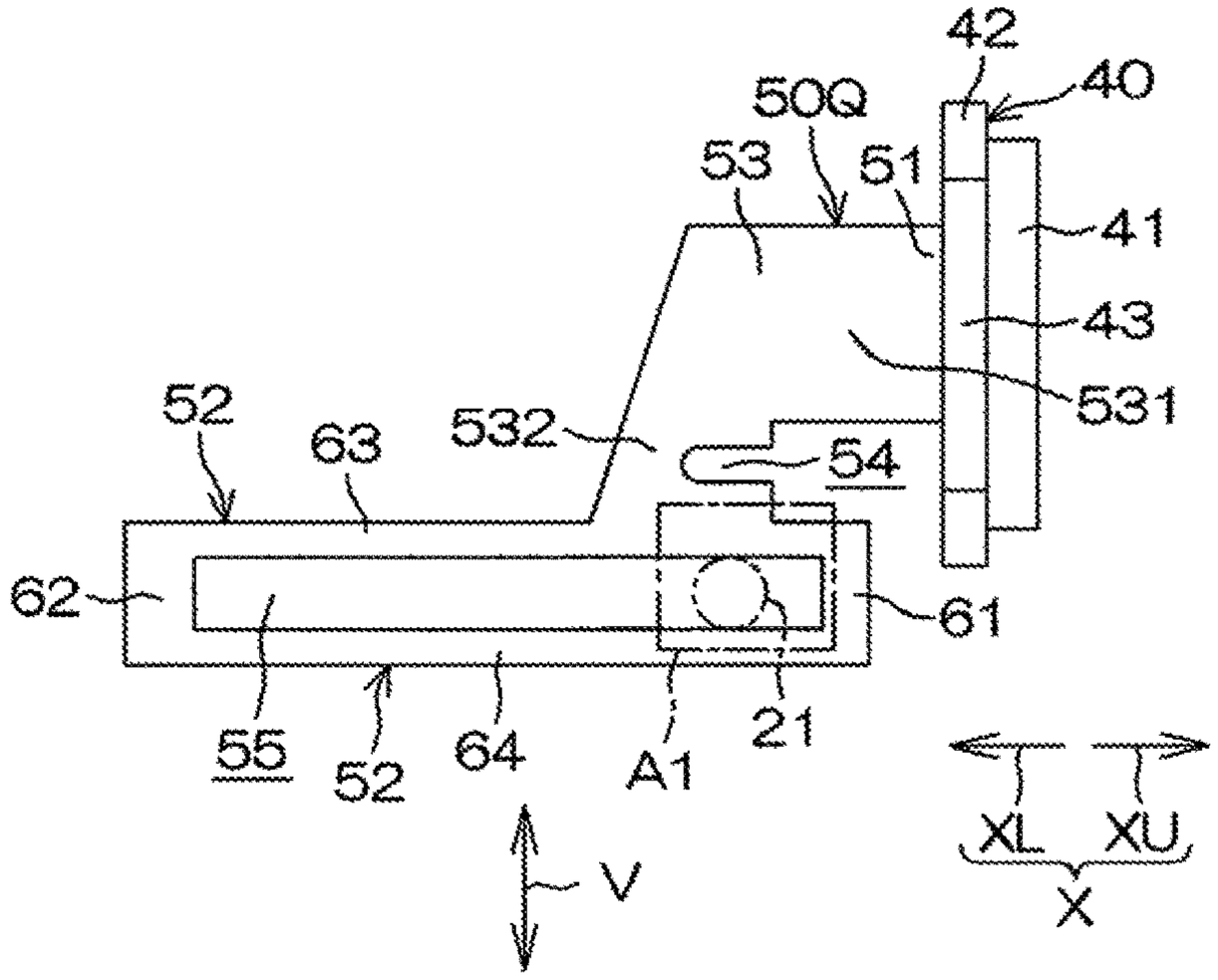

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FIG.9A

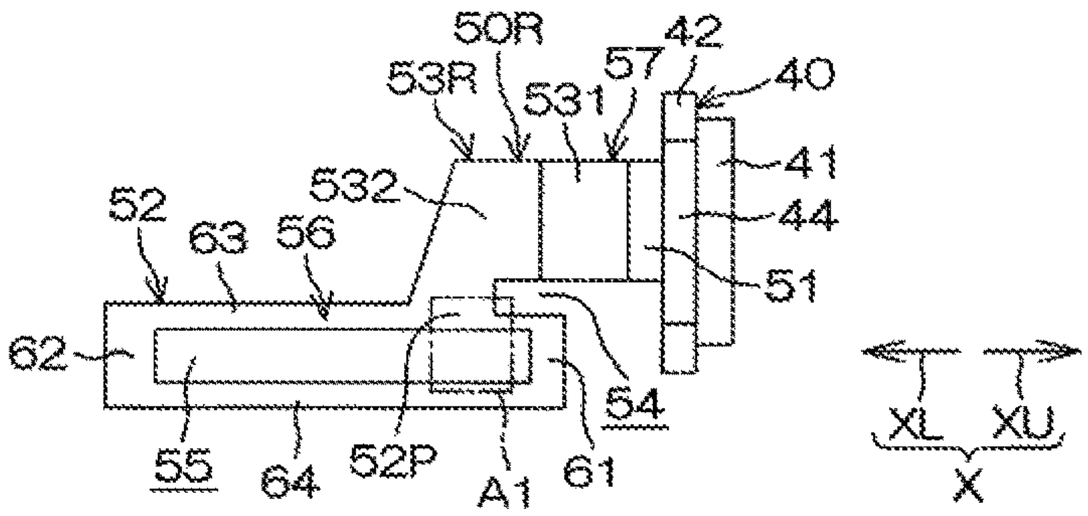


FIG.9B

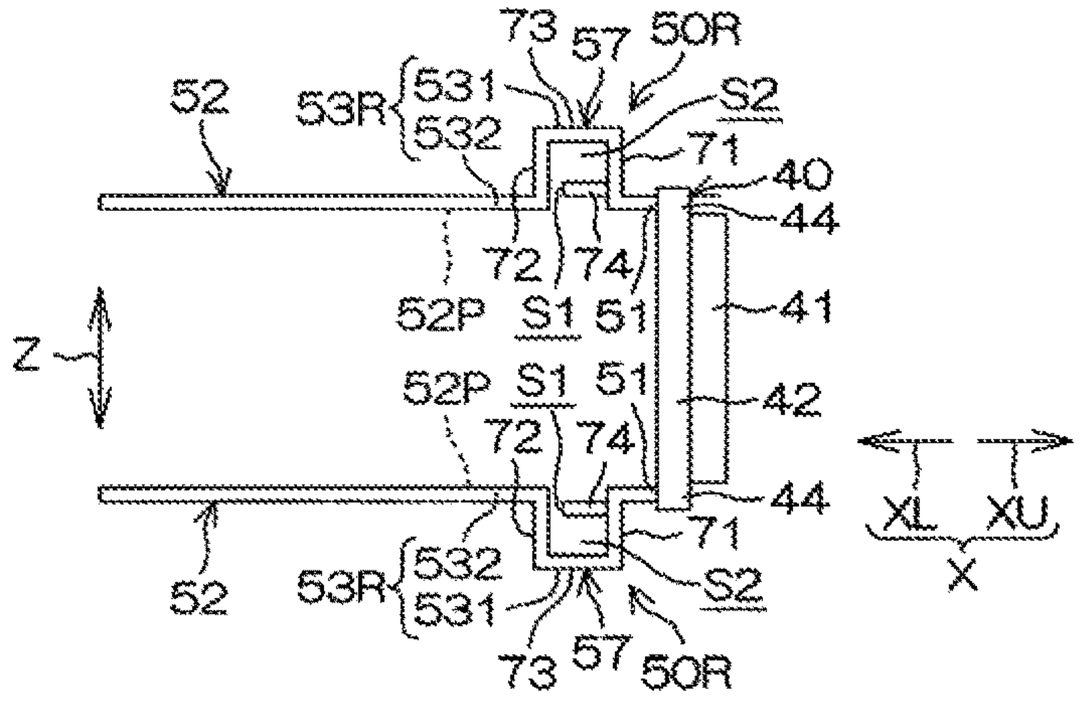


FIG.9C

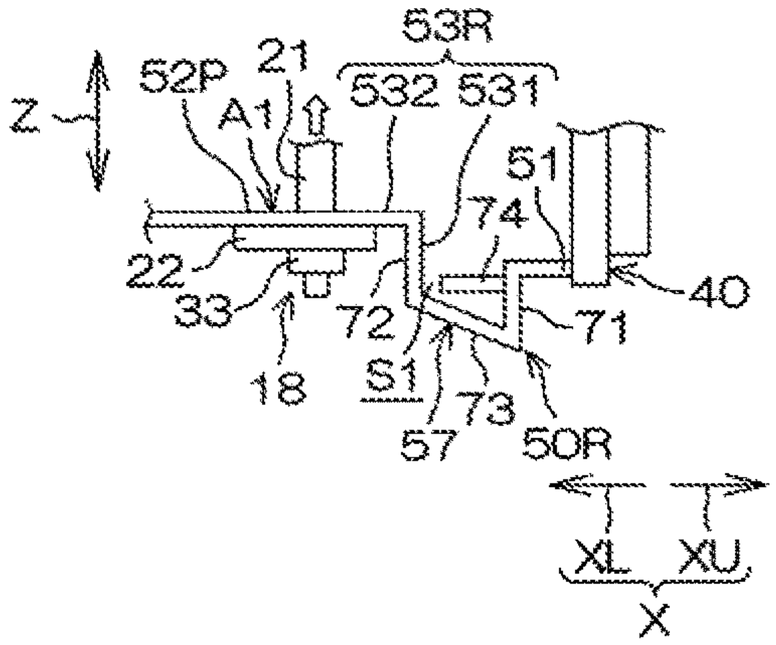


FIG.9D

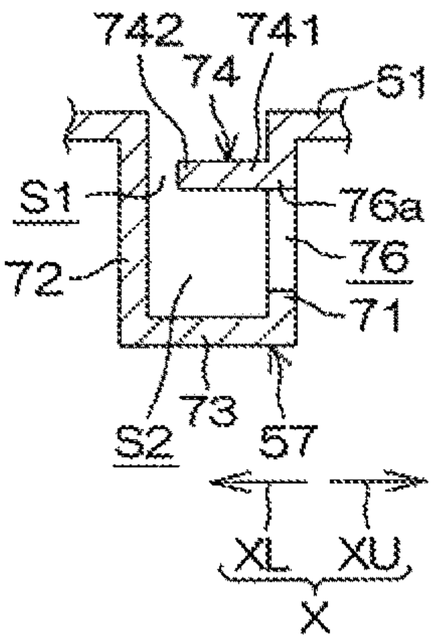


FIG.10

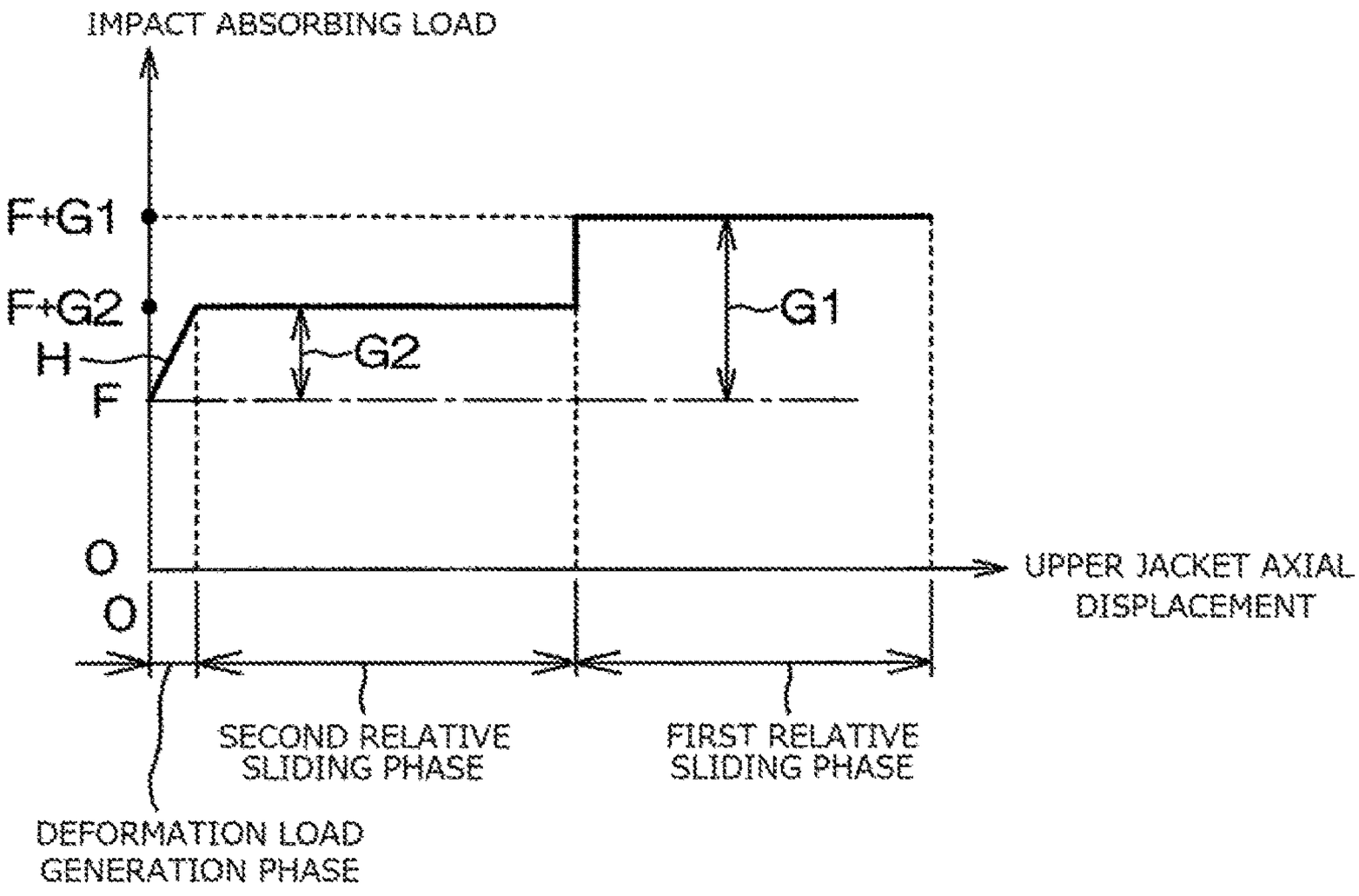


FIG.11A

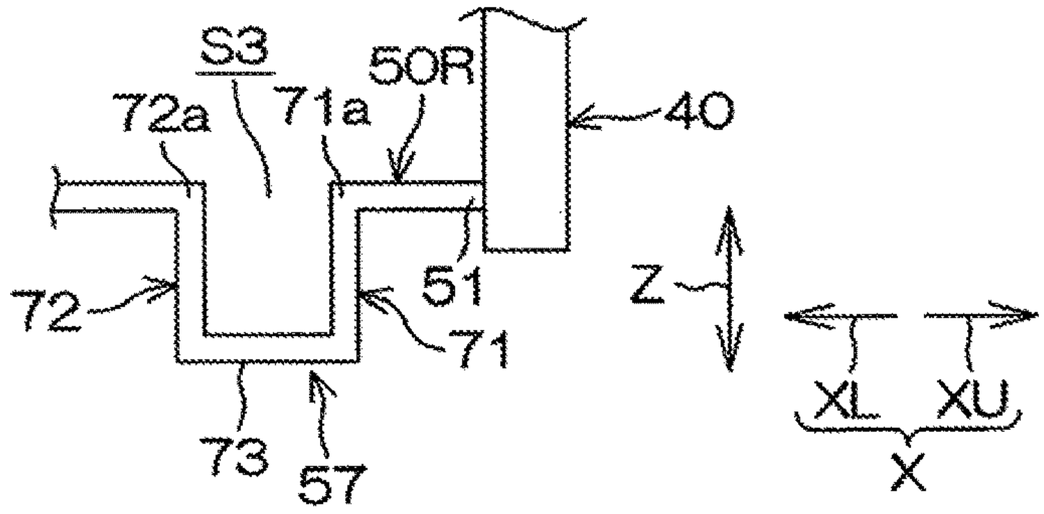


FIG.11B

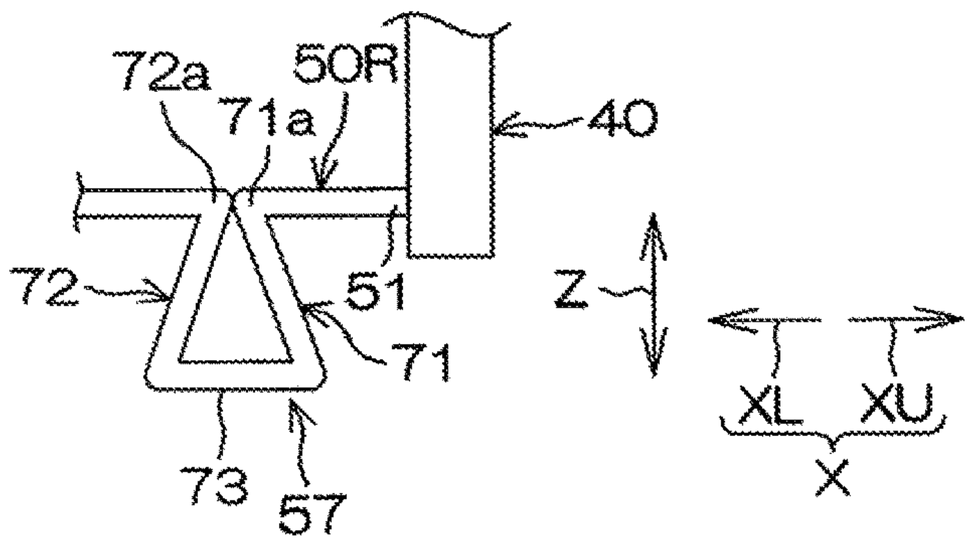


FIG.12

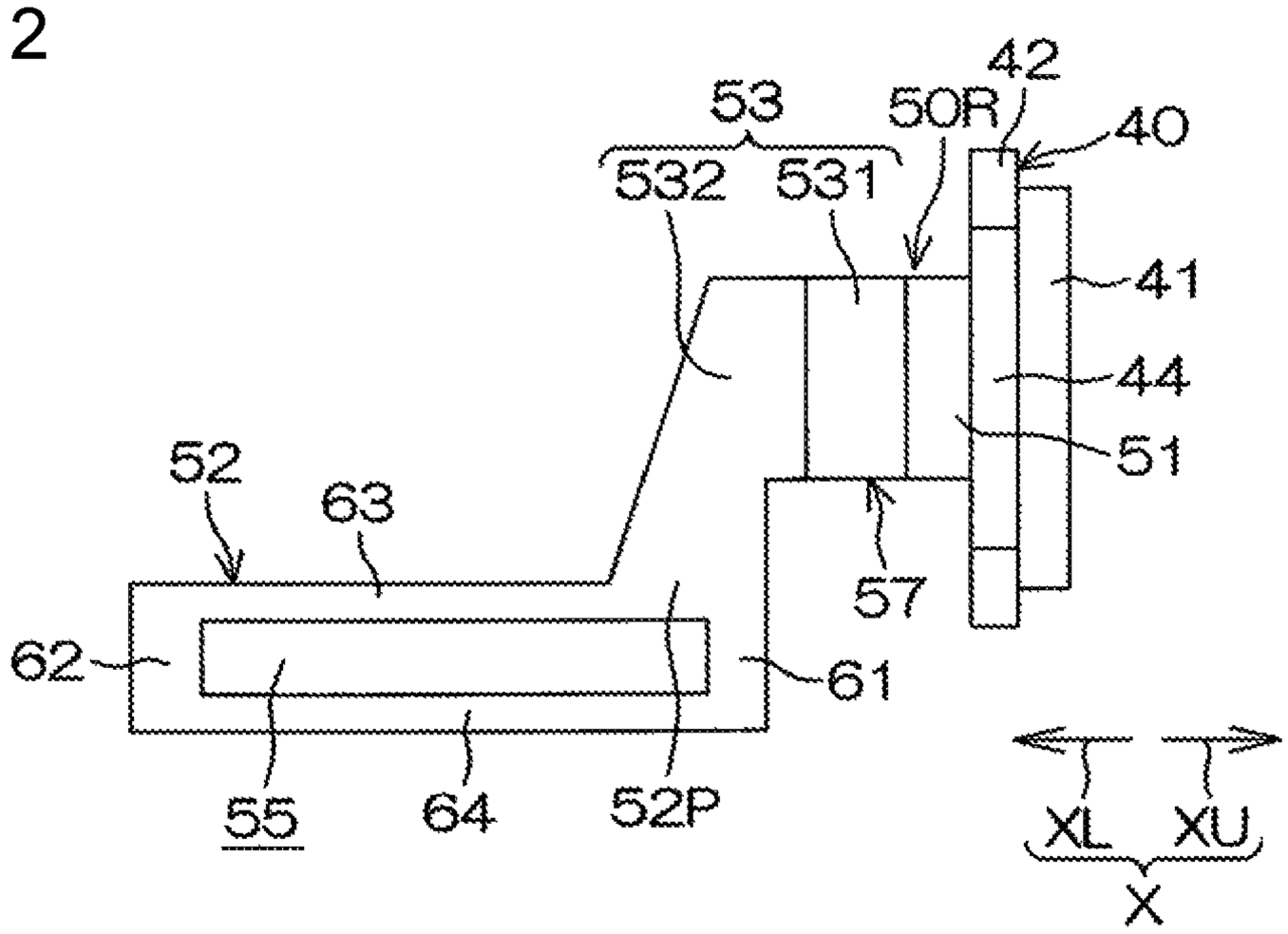


FIG.13A

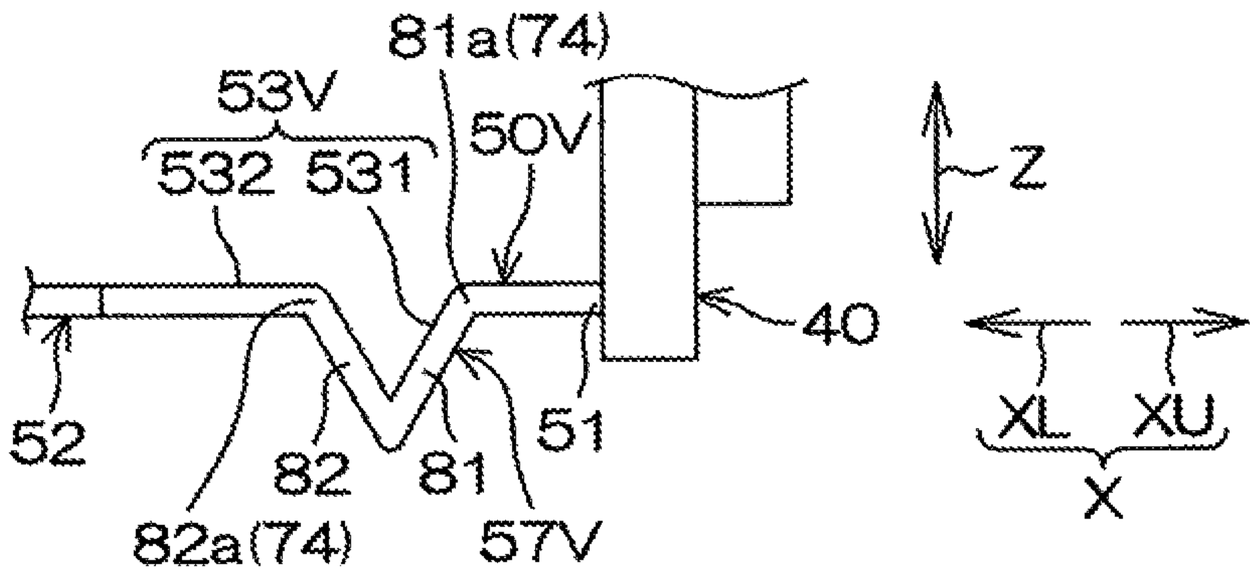


FIG.13B

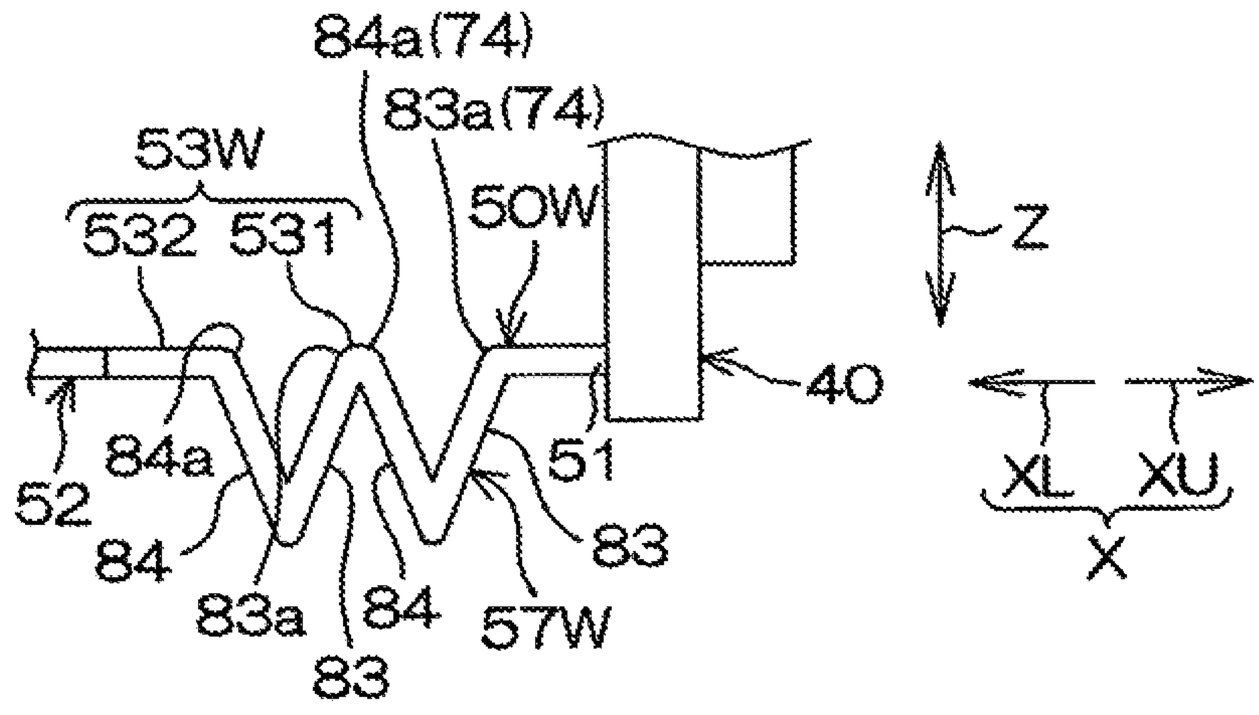


FIG.13C

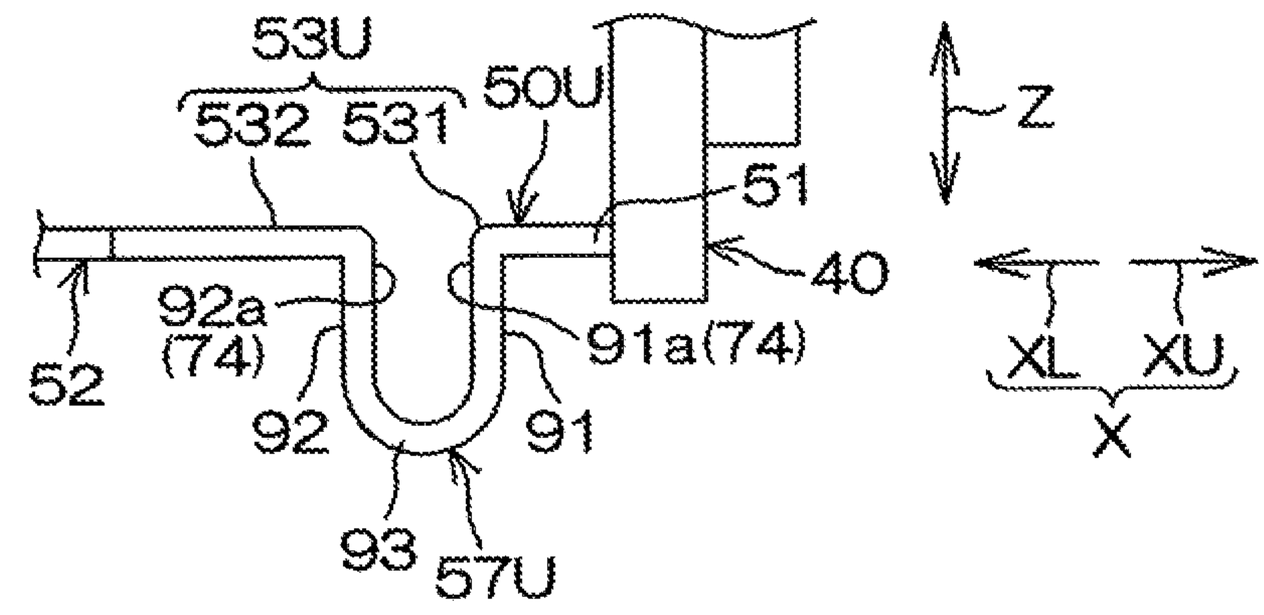
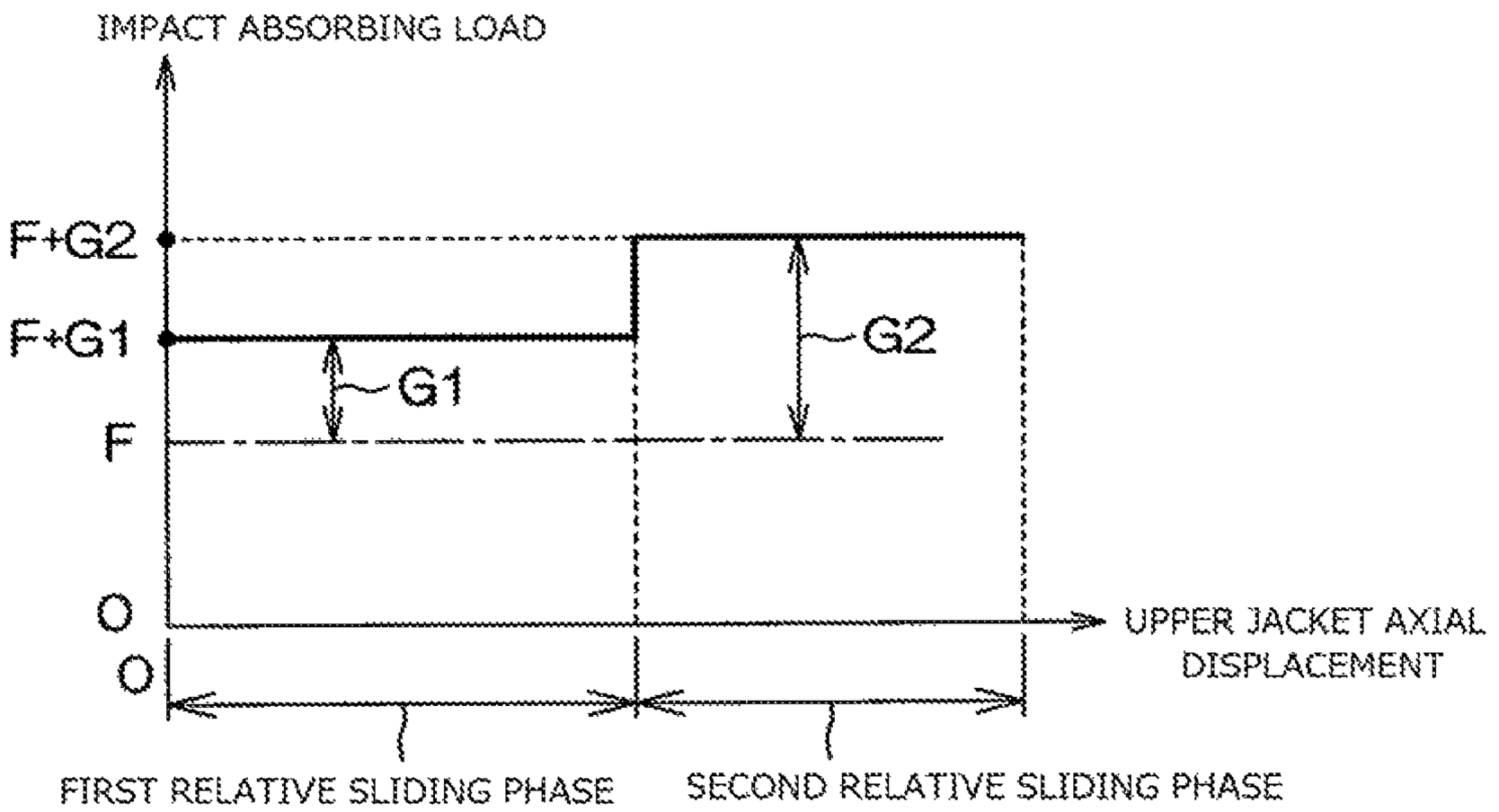


FIG.14


IMPACT ABSORBING LOAD
F+G2
F+G1
F
G1
G2
O
O
UPPER JACKET AXIAL DISPLACEMENT
FIRST RELATIVE SLIDING PHASE
SECOND RELATIVE SLIDING PHASE

STEERING APPARATUS

The disclosure of Japanese Patent Application No. 2017-023119 filed on Feb. 10, 2017 including the specification, drawings and abstract, is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a steering apparatus.

2. Description of Related Art

There are steering apparatuses that include: a fixed bracket that is coupled to a vehicle body and that is detachable in the event of a secondary impact; a movable bracket fixed to an upper jacket that is slidable relative to a lower jacket in a column axis direction; and a clamping mechanism that clamps the fixed bracket and the movable bracket together, thereby locking a telescopic position and a tilt position. In some known steering apparatuses of this type, a telescopic friction plate that extends in the column axis direction is fixed at one end to the movable bracket, a tilt friction plate is fixed to the fixed bracket, and the clamping mechanism clamps the telescopic friction plate and the tilt friction plate together (refer to, for example, Japanese Patent Application Publication No. 2009-29224 (JP 2009-29224 A)). This locks the telescopic position and the tilt position more firmly.

According to JP 2009-29224 A, the fixed bracket that is detachable from a vehicle body, the upper jacket, the movable bracket, and the friction plates all move together during a secondary impact in the column axis direction. This does not generate impact absorbing load from relative sliding between the telescopic friction plate and the tilt friction plate.

In recent years, there has been a demand for increasing impact absorbing load during a secondary impact. One approach to generating impact absorbing load may be to use an extension member that moves together with the upper jacket, that extends in the column axis direction, and that is clamped by the clamping mechanism, and to cause the extension member to slide, during a secondary impact, relative to a counter member that is immovable in the column axis direction. However, this approach may raise new issues as described below.

When a telescopic adjustment position changes, a clamped position where the extension member is clamped by the clamping mechanism changes accordingly in the longitudinal direction of the extension member (corresponding to the column axis direction). Further, the extension member deflects in a lateral direction (a vehicle width direction) with difficulty at a portion (e.g., an end) that is coupled to a member of the upper jacket at a predetermined location in the longitudinal direction, whereas the extension member deflects in the lateral direction easily at another portion that is far from the coupled portion in the longitudinal direction. Therefore, differences in the telescopic adjustment position may cause variations in impact absorbing load that is generated when the extension member slides relative to a counter member during a secondary impact.

SUMMARY OF THE INVENTION

A purpose of the invention is to provide a steering apparatus that reduces variations in impact absorbing load caused by differences in a telescopic adjustment position.

According to a first aspect of the invention, a steering apparatus includes: an upper jacket having a first end in a column axis direction, the first end being coupled to a steering member; a lower jacket slidably fitted externally on a second end of the upper jacket in the column axis direction; a supporting member that is fixed to a vehicle body and that supports the lower jacket; a clamping mechanism that holds the upper jacket in a position relative to the lower jacket by clamping the lower jacket to the upper jacket; a holding member held by the upper jacket; and a resistive force generating mechanism that is movable together with the holding member in the column axis direction and that slides, when the upper jacket moves relative to the lower jacket during a secondary impact, relative to at least one of the supporting member and the lower jacket so as to generate a resistive force against movement of the upper jacket. In the steering apparatus, the resistive force generating mechanism includes a fixed portion fixed to the holding member, and an extension portion extending in the column axis direction and having a coupled portion that is coupled to the fixed portion at a predetermined location in the column axis direction, the clamping mechanism clamps the lower jacket to the upper jacket via the supporting member and the extension portion, and the resistive force generating mechanism further includes a coupling stiffness reducing mechanism that reduces coupling stiffness between the fixed portion and the coupled portion of the extension portion so as to facilitate, when the clamping mechanism clamps the lower jacket to the upper jacket, deflection of the coupled portion of the extension portion relative to the fixed portion in a lateral direction as seen from the column axis direction.

According to this aspect, in the resistive force generating mechanism, the coupling stiffness reducing mechanism reduces the coupling stiffness between the fixed portion and the coupled portion of the extension portion that is located at a predetermined location in the column axis direction. Thus, when a region of the extension portion that includes the coupled portion is clamped by the clamping mechanism, the coupled portion of the extension portion deflects easily in the lateral direction as seen from the column axis direction. This reduces a difference in deflection strength of the extension portion in the lateral direction between when the region of the extension portion that includes the coupled portion is mainly clamped and when another region of the extension portion that is far from the coupled portion in the column axis direction is mainly clamped. Thus, a change in a clamped position where the extension portion is clamped after a telescopic adjustment is less likely to cause a change in the deflection strength of the extension portion in the lateral direction. Accordingly, the resistive force that is generated, during the secondary impact, by the sliding of the resistive force generating mechanism relative to at least one of the supporting member and the lower jacket is likely to remain unchanged, regardless of where the relative sliding occurs. This reduces variations in impact absorbing load caused by differences in a telescopic adjustment position.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and further features and advantages of the invention will become apparent from the following description of example embodiments with reference to the accompanying drawings, wherein like numerals are used to represent like elements and wherein:

FIG. **1** is a diagram illustrating the schematic structure of a steering apparatus according to a first embodiment of the invention;

FIG. **2** is a cross-sectional view taken along line II-II in FIG. **1**;

FIG. **3** is a perspective view illustrating first and second sliding members of the steering apparatus;

FIG. **4**A is a cross-sectional view taken along line IV-IV in FIG. **1**;

FIG. **4**B is a partially cutaway view of FIG. **4**A;

FIG. **5** is a bottom view of an area around the first sliding member and the second sliding member;

FIG. **6**A is a diagram illustrating an area around the sliding members in the event of a secondary impact;

FIG. **6**B is a diagram illustrating the area around the sliding members in the event of a secondary impact;

FIG. **7** is a graph illustrating the relationship between an axial displacement of an upper jacket and an impact absorbing load in the event of a secondary impact;

FIG. **8** is a side view of a first sliding member and a second sliding member of a steering apparatus according to a second embodiment of the invention;

FIG. **9**A is a schematic side view of a first sliding member and a second sliding member of a steering apparatus according to a third embodiment of the invention;

FIG. **9**B is a schematic plan view of the first sliding member and the second sliding member;

FIG. **9**C is a schematic plan view illustrating the main part of the first sliding member, the second sliding member, and a clamping mechanism;

FIG. **9**D is an enlarged cross-sectional view of a structure around a bent portion;

FIG. **10** is a graph according to the third embodiment and illustrating the relationship between an axial displacement of an upper jacket and an impact absorbing load in the event of a secondary impact;

FIG. **11**A is a diagram illustrating a structure around a bent portion of a steering apparatus according to a fourth embodiment of the invention;

FIG. **11**B is a diagram illustrating the structure around the bent portion of the steering apparatus according to the fourth embodiment of the invention;

FIG. **12** is a schematic side view of a first sliding member and a second sliding member of a steering apparatus according to a fifth embodiment of the invention;

FIG. **13**A is a schematic plan view illustrating the main part of a first sliding member, a second sliding member, and a clamping mechanism of a steering apparatus according to a sixth embodiment of the invention;

FIG. **13**B is a schematic plan view illustrating the main part of a first sliding member, a second sliding member, and a clamping mechanism of a steering apparatus according to a seventh embodiment of the invention;

FIG. **13**C is a schematic plan view illustrating the main part of a first sliding member, a second sliding member, and a clamping mechanism of a steering apparatus according to an eighth embodiment of the invention; and

FIG. **14** is a graph according to a ninth embodiment of the invention and illustrating the relationship between an axial displacement of an upper jacket and an impact absorbing load in the event of a secondary impact.

DETAILED DESCRIPTION OF EMBODIMENTS

Embodiments of the invention will be described in detail below with reference to the accompanying drawings. FIG. **1** is a diagram illustrating the schematic structure of a steering apparatus **1** according to a first embodiment of the invention. The steering apparatus **1** includes a steering shaft **3**, a column jacket **6**, an intermediate shaft **4**, and a steering

operation mechanism **5**. A steering member **2**, such as a steering wheel, is coupled to one end (an axial upper end) of the steering shaft **3**. The steering apparatus **1** steers steered wheels (not illustrated) in synchronization with steering of the steering member **2**. The steering operation mechanism **5** may be, for example, but not limited to, a rack-and-pinion mechanism.

In the description below, an upper side in a column axis direction X that is an axial direction of the steering shaft **3** is referred to as an axial upper side XU, and a lower side in the column axis direction X is referred to as an axial lower side XL. The steering shaft **3** has a tubular upper shaft **3**U and a lower shaft **3**L. The upper shaft **3**U and the lower shaft **3**L are coupled together with a spline fit, a serration fit, or any other suitable fit that allows relative movement between the upper shaft **3**U and the lower shaft **3**L. The steering member **2** is coupled to one end of the upper shaft **3**U on the axial upper side XU.

The column jacket **6** includes the following: an upper jacket **7** having a first end that is coupled to the steering member **2** via the upper shaft **3**U; and a lower jacket **8** slidably fitted externally on a second end of the upper jacket **7**. The upper jacket **7** is also an inner jacket, and the lower jacket **8** is also an outer jacket. The first end of the upper jacket **7** is coupled to the steering member **2** via the upper shaft **3**U. The column axis direction X is also an axial direction of the upper jacket **7** and an axial direction of the lower jacket **8**. The axial upper side XU is also the first end side of the upper jacket **7**, and the axial lower side XL is also the second end side of the upper jacket **7**.

The steering shaft **3** is inserted through the column jacket **6**. The upper shaft **3**U is supported by a bearing **9** rotatably with respect to the upper jacket **7**. The lower shaft **3**L is supported by a bearing **10** rotatably with respect to the lower jacket **8**. The movement of the upper shaft **3**U in the column axis direction X relative to the lower shaft **3**L causes the movement of the upper jacket **7** in the column axis direction X relative to the lower jacket **8**. The column jacket **6** is telescopically movable together with the steering shaft **3** in the column axis direction X.

The position of the steering member **2** in a vehicle longitudinal direction is adjustable by extending and retracting the steering shaft **3** and the column jacket **6** in the column axis direction X. As such, the steering apparatus **1** has a telescopic adjustment feature. The telescopic adjustment is achieved by sliding the upper jacket **7** within a predetermined telescopic adjustment range. The telescopic adjustment range is an area between an upward adjustment limit position to which an upward adjustment of the upper jacket **7** in the column axis direction X is limited and a downward adjustment limit position to which a downward adjustment of the upper jacket **7** in the column axis direction X is limited. The column jacket **6** is fully extended when the upper jacket **7** is in the upward adjustment limit position and is fully retracted when the upper jacket **7** is in the downward adjustment limit position.

FIG. **2** is a cross-sectional view taken along line II-II in FIG. **1**. A guide groove **27** having an elongate shape in the column axis direction X is formed in the upper jacket **7**. A guided projection **28** that fits in the guide groove **27** and that is movable in the column axis direction X relative to the guide groove **27** is fixed to the lower jacket **8**. The guided projection **28** is inserted through an insertion hole **8***b* formed in the lower jacket **8**. The guided projection **28** includes the following: a head portion **28***a* that abuts against an outer peripheral surface of the lower jacket **8** along the edge of the insertion hole **8***b*; and a shank portion **28***b* inserted through

the insertion hole **8***b*. The head portion **28***a* and the shank portion **28***b* are formed as one piece. The tip of the shank portion **28***b* fits in the guide groove **27**.

In the telescopic adjustment, abutment of an axial lower end of the guide groove **27** against the guided projection **28** limits the upper jacket **7** to the upward adjustment limit position of the telescopic adjustment range. This prevents the upper jacket **7** from coming off the lower jacket **8**. Further, in the telescopic adjustment, abutment of an axial upper end of the guide groove **27** against the guided projection **28** limits the upper jacket **7** to the downward adjustment limit position of the telescopic adjustment range.

Referring to FIG. **1**, the steering apparatus **1** includes the following: a mounting bracket **14** fixed to a vehicle body **13**; a tilt center shaft **15** supported by the mounting bracket **14**; a column bracket **16** fixed to an outer periphery of the lower jacket **8** and rotatably supported by the tilt center shaft **15**. The steering shaft **3** and the column jacket **6** are pivotable in a tilt direction Y (substantially in a vertical direction) about a tilt center CC that is the central axis of the tilt center shaft **15**.

The position of the steering member **2** in the tilt direction Y is adjustable by pivoting the steering shaft **3** and the column jacket **6** about the tilt center CC. As such, the steering apparatus **1** has a tilt adjustment feature. Referring to FIG. **2**, the steering apparatus **1** includes the following: a supporting member **17**, such as a bracket, that is fixed to the vehicle body **13** and that supports the lower jacket **8**; and a clamping mechanism **18** that locks the position of the upper jacket **7** after the tilt adjustment and the telescopic adjustment. The clamping mechanism **18** clamps, via the supporting member **17**, a pair of clamped portions **19** that are integral with an upper part of the lower jacket **8** in the column axis direction X.

The lower jacket **8** has a slit **26** that extends from an axial upper end **8***a* of the lower jacket **8** toward the axial lower side XL. The slit **26** is provided between the clamped portions **19**. The clamping mechanism **18** is mounted to the clamped portions **19**. When the clamping mechanism **18** clamps the clamped portions **19**, the lower jacket **8** is elastically compressed radially, thus clamping the upper jacket **7**.

The supporting member **17** includes the following: an attachment plate **24** attached to the vehicle body **13**; and a pair of side plates **22** extending downward in the tilt direction Y from the opposite ends of the attachment plate **24**. The side plates **22** each have a tilt long hole **23** that extends in the tilt direction Y and that is used for the tilt adjustment. The clamped portions **19** of the lower jacket **8** are located between the side plates **22**. Each of the clamped portions **19** has a plate shape that extends along an inner surface **22***a* of a corresponding one of the side plates **22**. Each of the clamped portions **19** has a shaft insertion hole **29** that is circular.

The clamping mechanism **18** includes a clamping shaft **21** (an insertion shaft) and an operating lever **20** that rotates the clamping shaft **21**. A central axis C**1** of the clamping shaft **21** corresponds to the center of rotation of the operating lever **20**. The clamping shaft **21** may be, for example, a bolt. The clamping shaft **21** is inserted through the tilt long holes **23** in the side plates **22** of the supporting member **17** and the shaft insertion holes **29** in the clamped portions **19** of the lower jacket **8**. In the tilt adjustment, the clamping shaft **21** and the lower jacket **8** move relative to the supporting member **17**. At this time, the clamping shaft **21** moves in the tilt long holes **23** in the tilt direction Y.

A head portion **21***a* provided at one end of the clamping shaft **21** is fixed to the operating lever **20** and is rotatable together with the operating lever **20**. The clamping mechanism **18** further includes a force conversion mechanism **30** that is interposed between the head portion **21***a* of the clamping shaft **21** and one of the side plates **22** (the left side plate **22** in FIG. **2**, hereinafter referred to as the first side plate **22**). The force conversion mechanism **30** converts operating torque of the operating lever **20** to an axial force (a clamping force that clamps the pair of side plates **22**). The force conversion mechanism **30** includes a rotating cam **31** and a first clamping member **32**. The rotating cam **31** is coupled to the operating lever **20** and is rotatable together with the operating lever **20**. The movement of the rotating cam **31**, relative to the clamping shaft **21**, in a clamping shaft direction J is limited. The clamping shaft direction J is a direction in which the central axis C**1** extends. The first clamping member **32** clamps the first side plate **22** through cam engagement with the rotating cam **31**. The first clamping member **32** is a non-rotating cam whose rotation is limited. The first clamping member **32** faces one of the clamped portions **19** (the left clamped portion **19** in FIG. **2**, hereinafter referred to as the first clamped portion **19**) of the lower jacket **8** in the clamping shaft direction J.

The clamping mechanism **18** further includes the following: a second clamping member **33** that clamps the other of the side plates **22** (the right side plate **22** in FIG. **2**, hereinafter referred to as the second side plate **22**); and a needle roller bearing **37** interposed between the second clamping member **33** and the second side plate **22**. The second clamping member **33** is a nut threadedly engaged with a threaded portion **21***b* provided at the other end of the clamping shaft **21**. The second clamping member **33** clamps the second side plate **22** via the needle roller bearing **37**. The second clamping member **33** faces the other of the clamped portions **19** (the right clamped portion **19** in FIG. **2**, hereinafter referred to as the second clamped portion **19**) of the lower jacket **8** in the clamping shaft direction J.

The rotating cam **31**, the first clamping member **32**, and the needle roller bearing **37** are supported on the outer periphery of the clamping shaft **21**. The first clamping member **32** fits in the tilt long hole **23** in the first side plate **22** such that rotation of the first clamping member **32** is limited. When the operating lever **20** rotates in a lock direction, the rotating cam **31** rotates relative to the first clamping member **32**, and the first clamping member **32** moves in a direction away from the rotating cam **31** along the clamping shaft direction J. As such, the side plates **22** are clamped by being sandwiched between the clamping members **32** and **33**.

At this time, each of the side plates **22** of the supporting member **17** clamps the corresponding clamped portion **19** of the lower jacket **8**. This limits the movement of the lower jacket **8** in the tilt direction Y so that a tilt lock is achieved. Further, when the clamped portions **19** are clamped, the lower jacket **8** is elastically compressed radially and clamps the upper jacket **7** accordingly. Thus, the upper jacket **7** is locked (held) in a desired telescopic adjustment position within the telescopic adjustment range so that a telescopic lock is achieved.

As described above, the clamping mechanism **18** holds the upper jacket **7** in a position relative to the lower jacket **8** by clamping the lower jacket **8** to the upper jacket **7** via the supporting member **17**. In contrast, when the operating lever **20** rotates in an unlock direction, the first clamping member **32** moves, with rotation of the rotating cam **31**, in a direction toward the rotating cam **31** along the clamping shaft direc-

tion J. Thus, the side plates **22** are declamped from the clamping members **32** and **33**, so that the tilt adjustment and the telescopic adjustment are available.

Referring to FIG. **3**, the steering apparatus **1** further includes a first sliding member **40** and a pair of second sliding members **50**. FIG. **4**A is a cross-sectional view taken along line IV-IV in FIG. **1**. FIG. **4**B is a partially cutaway view of FIG. **4**A. FIG. **5** is a bottom view of an area around the first sliding member **40** and the second sliding members **50**. Referring to FIG. **4**A, the first sliding member **40** is attached to the upper jacket **7** and is frictionally slidable relative to the upper jacket **7**. The first sliding member **40** is a holding member held by the upper jacket **7** through press-fit and has a feature to hold the second sliding members **50** to the upper jacket **7**. Frictional sliding between the first sliding member **40** and the upper jacket **7** is hereinafter referred to as first relative sliding. A resistive force, generated by the first relative sliding, against the movement of the upper jacket **7** is hereinafter referred to as a first resistive force G**1**. The first sliding member **40** forms a first resistive force generating mechanism.

The first sliding member **40** includes the following: a tubular fitting portion **41** fitted on an outer peripheral surface of the upper jacket **7**; an annular flange portion **42** extending outward from an end of the fitting portion **41** in a radial direction of the upper jacket **7**; and multiple (eight in this embodiment) projecting portions **43** that project from an inner peripheral surface of the fitting portion **41** toward the outer peripheral surface of the upper jacket **7** and that are in contact with the outer peripheral surface of the upper jacket **7**. The first resistive force G**1** generated by the first relative sliding is adjustable by adjusting the strength of the projecting portions **43** and a frictional force between the outer peripheral surface of the upper jacket **7** and the projecting portions **43**. The projecting portions **43** are evenly spaced in a circumferential direction C of the outer peripheral surface of the upper jacket **7**. This arrangement of the projecting portions **43** facilitates stabilizing the first resistive force G**1**.

The first sliding member **40** further includes a pair of fixing portions **44** that fix the second sliding members **50**. Each of the fixing portions **44** extends radially outward from an outer edge of the flange portion **42** in a radial direction R. The radial direction R is a radial direction with respect to a central axis C**2** of the upper jacket **7**. The term "radially outward" refers to a direction away from the central axis C**2** in the radial direction R. The fixing portions **44** are displaced from each other by 180 degrees in the circumferential direction C so that the upper jacket **7** is located between the fixing portions **44**.

Referring to FIG. **5**, a component **100** to be attached, such as a combination switch or a key lock, is attached to the upper jacket **7**. The component **100** is attached to a portion of the upper jacket **7** that is located closer to the axial upper side XU than a portion of the upper jacket **7** that the first sliding member **40** is attached to. The steering apparatus **1** further includes a facing member **101** fixed to the upper jacket **7**. In the column axis direction X, the facing member **101** is located closer to the steering member **2** (i.e., closer to the axial upper side XU) than the first sliding member **40** and faces the first sliding member **40**. In the upper jacket **7**, an axial lower end of the facing member **101** is located between the component **100** and the first sliding member **40**. The facing member **101** may be, for example, a bracket for attaching the component **100** to the upper jacket **7**. The bracket is fixed to the upper jacket **7** by welding, clinching, press-fit, or any other suitable fixing method. The facing member **101** is not limited to a bracket for attaching the component **100** to the upper jacket **7**. For example, the facing member **101** may be a bracket for attaching a vehicle component (e.g., a column cover, a wire harness, a knee airbag, etc.) other than the component **100** to the upper jacket **7**.

Referring to FIG. **3**, each of the second sliding members **50** is a plate-like member extending from the first sliding member **40** toward the axial lower side XL. The second sliding members **50** are formed as separate pieces from the first sliding member **40** and then are fixed to the first sliding member **40** by welding or the like. Thus, the second sliding members **50** are movable together with the first sliding member **40** in the column axis direction X. Each of the second sliding members **50** is joined to an axial lower end surface of a corresponding one of the fixing portions **44** of the first sliding member **40**. In the telescopic adjustment, the second sliding members **50** move together with the upper jacket **7** as well as the first sliding member **40**.

Referring to FIG. **5**, the second sliding members **50** are spaced from each other across the upper jacket **7** in the clamping shaft direction J and face each other in the clamping shaft direction J. One of the second sliding members **50** is located between the first clamping member **32** and the first clamped portions **19** (the upper clamped portion **19** in FIG. **5**). The one of the second sliding members **50** is located between the first side plate **22** (the upper side plate **22** in FIG. **5**) and the first clamped portion **19**. The other of the second sliding members **50** is located between the second clamping member **33** and the second clamped portions **19** (the lower clamped portion **19** in FIG. **5**). The other of the second sliding members **50** is located between the second side plate **22** (the lower side plate **22** in FIG. **5**) and the second clamped portion **19**.

In a clamping state of the clamping mechanism **18** (i.e., in a state where the lower jacket **8** is clamping the upper jacket **7**), each of the second sliding members **50** is kept pressed against a corresponding one of the clamped portions **19** by a corresponding one of the clamping members **32** and **33**. The clamping mechanism **18** presses each of the second sliding members **50** against the corresponding clamped portion **19** in a pressing direction P coincident with the clamping shaft direction J. A direction along the pressing direction P toward the corresponding clamped portion **19** is hereinafter referred to as the downstream side of the pressing direction P.

Each of the second sliding members **50** is held between the corresponding side plate **22** and the corresponding clamped portion **19** by being pressed against the corresponding clamped portion **19** by the corresponding one of the clamping members **32** and **33**. In this state, each of the second sliding members **50** is frictionally slidable relative to the corresponding side plate **22** and the corresponding clamped portion **19**. Frictional sliding that is caused, while the clamping mechanism **18** clamps the lower jacket **8** to the upper jacket **7**, between the pair of second sliding members **50** and each of the pair of side plates **22** and the pair of clamped portions **19** is hereinafter referred to as second relative sliding. A resistive force, generated by the second relative sliding, against the movement of the upper jacket **7** is hereinafter referred to as a second resistive force G**2**. The second sliding members **50** form a second resistive force generating mechanism. The second resistive force G**2** is adjustable by adjusting the fictional force between the second sliding members **50** and each of the side plates **22** and the clamped portions **19**. According to the first embodiment, the first resistive force G**1** generated by the first

relative sliding is greater than the second resistive force G2 generated by the second relative sliding (G1>G2).

Referring to FIG. **1** and FIG. **3**, each of the second sliding members **50** includes the following: a fixed portion **51** fixed to the first sliding member **40** by, for example, welding; an extension portion **52** extending parallel to the column axis direction X; a coupling portion **53** that couples, to the fixed portion **51**, a coupled portion **52**P of the extension portion **52** that is located at a predetermined location in the column axis direction X; and a slit **54** that serves as a coupling stiffness reducing mechanism for reducing coupling stiffness between the fixed portion **51** and the coupled portion **52**P of the extension portion **52**.

As illustrated in FIG. **3**, the extension portion **52** has a substantially rectangular plate shape with the long sides extending in the column axis direction X. The extension portion **52** has an axial long hole **55** extending in the column axis direction X. The clamping shaft **21** is inserted through the axial long hole **55** in the extension portion **52**. The axial long hole **55** in the extension portion **52** is defined by a first defining section **61**, a second defining section **62**, a third defining section **63**, and a fourth defining section **64**. The first defining section **61** defines the axial long hole **55** from the axial upper side XU. The second defining section **62** defines the axial long hole **55** from the axial lower side XL. The third defining section **63** and the fourth defining section **64** extend parallel to the column axis direction X and define the axial long hole **55** from above and below in a vertical direction V. The coupled portion **52**P of the extension portion **52** that is coupled via the coupling portion **53** to the fixed portion **51** is located in the third defining section **63** at a predetermined location in the column axis direction X.

The coupling portion **53** includes the following: a first coupling portion **531** coupled to the fixed portion **51** from the axial lower side XL; and a second coupling portion **532** that is interposed between the first coupling portion **531** and the extension portion **52** and that is coupled to the coupled portion **52**P of the extension portion **52** from above in the vertical direction V. The slit **54** reduces the coupling stiffness between the fixed portion **51** and the coupled portion **52**P of the extension portion **52** so as to facilitate deflection of the coupled portion **52**P of the extension portion **52** relative to the fixed portion **51** in a lateral direction Z as seen from the column axis direction X, as illustrated in FIG. **4**B. Specifically, the slit **54** is located above and adjacent to the coupled portion **52**P of the extension portion **52** in the vertical direction V and extends in the column axis direction X (refer to FIG. **3**).

As illustrated in FIG. **3**, the slit **54** is interposed between the first coupling portion **531** of the coupling portion **53** and the extension portion **52** so as to separate the first coupling portion **531** and the extension portion **52** from each other. One end of the slit **54** is open toward the axial upper side XU. The other end of the slit **54** extends toward the second coupling portion **532** of the coupling portion **53**. Thus, the slit **54** reduces the width over which the second coupling portion **532** of the coupling portion **53** is coupled to the extension portion **52** in the column axis direction X.

Referring to FIG. **5**, in the telescopic adjustment, the second sliding members **50** move together with the upper jacket **7** in the column axis direction X. In the telescopic adjustment, the clamping shaft **21** moves relative to the second sliding members **50** by moving in the axial long holes **55** along the column axis direction X. When the upper jacket **7** is in any position within the telescopic adjustment range, the clamping shaft **21** is spaced from both the first defining section **61** and the second defining section **62** that define the axial long hole **55**. Specifically, in the telescopic adjustment, even when the upper jacket **7** is in the downward adjustment limit position, the clamping shaft **21** is not contact with the first defining section **61** that defines the axial long hole **55**. In the telescopic adjustment, even when the upper jacket **7** is in the upward adjustment limit position, the clamping shaft **21** is not contact with the second defining section **62** that defines the axial long hole **55**.

In each of the second sliding members **50**, particularly, a part (the periphery of the axial long hole **55**) of the extension portion **52** that faces a corresponding one of the clamping members **32** and **33** is firmly held between the side plate **22** and the clamped portion **19**. During the second relative sliding, therefore, in the extension portion **52**, the third defining section **63** and the fourth defining section **64** that are located above and below the axial long hole **55** in the vertical direction V mainly slide frictionally on the side plate **22** and the clamped portion **19**. The third defining section **63** and the fourth defining section **64** of the extension portion **52** form a sliding portion **56** that mainly slides frictionally on the side plate **22** and the clamped portion **19**.

Next, how the steering apparatus **1** works when a secondary impact occurs in the event of a vehicle collision will be described. The term "secondary impact" means that a driver of a vehicle impacts the steering member **2** in the event of a collision of the vehicle. Unless otherwise specified, the description below assumes that the secondary impact occurs with the upper jacket **7** in the upward adjustment limit position. When the secondary impact occurs in the clamping state of the clamping mechanism **18**, the impact force is transmitted to the upper jacket **7** through the steering member **2**. The lower jacket **8** is supported by the pair of side plates **22** of the supporting member **17** that is fixed to the vehicle body **13**. For this reason, during the secondary impact, the upper jacket **7** moves toward the axial lower side XL, relative to the supporting member **17** and the lower jacket **8**. Thus, the upper jacket **7** slides frictionally on the lower jacket **8** so that the column jacket **6** is retracted. A resistive force that is caused when the upper jacket **7** slides frictionally on the lower jacket **8** in the clamping state of the clamping mechanism **18** is hereinafter referred to as a column resistive force F.

FIG. **6**A is a diagram illustrating an area around the first sliding member **40** and the second sliding members **50** in the event of the secondary impact. FIG. **6**B illustrates a state appearing after the state of FIG. **6**A. FIG. **7** is a graph illustrating the relationship between an axial displacement of the upper jacket **7** and an impact absorbing load in the event of the secondary impact. In FIG. **7**, the horizontal axis represents the axial displacement of the upper jacket **7**, and the vertical axis represents the impact absorbing load. The origin on the horizontal axis is set to the position of the upper jacket **7** in the column axis direction X when the column jacket **6** is fully extended (i.e., when the upper jacket **7** is in the upward adjustment limit position).

According to the first embodiment, as illustrated in FIG. **7**, the first resistive force G1 generated by the first relative sliding is greater than the second resistive force G2 generated by the second relative sliding (G1>G2). Thus, the second relative sliding starts first. The movement of the second sliding members **50** relative to the supporting member **17** and the lower jacket **8** changes the sliding portions **56**. Specifically, after the secondary impact occurs, the sliding portions **56** move over time toward the first sliding member **40** (toward the axial upper side XU).

The impact absorbing load during an initial phase of the secondary impact (corresponding to a second relative sliding

phase in FIG. **7**) corresponds to the sum (F+G**2**) of the second resistive force G**2** generated by the second relative sliding and the column resistive force F caused by the frictional sliding of the upper jacket **7** on the lower jacket **8** (refer to FIG. **7**). The abutment of the axial lower end of the guide groove **27** against the guided projection **28** occurs somewhere during the second relative sliding phase, thus breaking the guided projection **28**. The second relative sliding continues even after the guided projection **28** has been broken. Thus, regardless of the position of the upper jacket **7** after the telescopic adjustment, the second relative sliding starts immediately after the secondary impact occurs.

As illustrated in FIG. **6**A, the first sliding member **40** abuts against the axial upper end **8***a* of the lower jacket **8**. This abutment limits the movement of the first sliding member **40** and the second sliding members **50** toward the axial lower side XL, relative to the lower jacket **8** and the supporting member **17**. Thus, the movement of the second sliding members **50** relative to the supporting member **17** and the lower jacket **8** is stopped, so that the second relative sliding is stopped. At this time, the axial upper end **8***a* of the lower jacket **8** serves as a second stopper for stopping the second relative sliding. In contrast, the upper jacket **7** continues moving toward the axial lower side XL, relative to the lower jacket **8**. Thus, the relative movement (the first relative sliding) between the upper jacket **7** and the first sliding member **40** starts.

The impact absorbing load during a phase after the start of the first relative sliding (corresponding to a first relative sliding phase in FIG. **7**) corresponds to the sum (F+G**1**) of the first resistive force G**1** generated by the first relative sliding and the column resistive force F caused by the frictional sliding of the upper jacket **7** on the lower jacket **8** (refer to FIG. **7**). When the facing member **101** abuts against the first sliding member **40** from the axial upper side XU, the first relative sliding is stopped (refer to FIG. **6**B).

According to the first embodiment, the second sliding members **50** are attached to the first sliding member **40** (a holding member) and are movable together with the first sliding member **40**. Thus, the movement of the upper jacket **7** relative to the lower jacket **8** during the secondary impact generates either relative sliding (the first relative sliding) between the upper jacket **7** and the first sliding member **40**, or relative sliding (the second relative sliding) between the second sliding members **50** and each of the lower jacket **8** and the supporting member **17**.

According to the first embodiment, the first resistive force G**1** generated by the first relative sliding is greater than the second resistive force G**2** generated by the second relative sliding. Thus, as illustrated in FIG. **7**, the following phases are obtainable during the secondary impact in accordance with the axial position of the upper jacket **7** relative to the lower jacket **8**: the second relative sliding phase that generates impact absorbing load (F+G**2**) that is the sum of the second resistive force G**2** and the column resistive force F caused by the frictional sliding of the upper jacket **7** on the lower jacket **8**; and the first relative sliding phase that follows the second relative sliding phase and that generates impact absorbing load (F+G**1**) that is the sum of the first resistive force G**1** and the column resistive force F. Setting the magnitudes of the first resistive force G**1** and the second resistive force G**2** appropriately allows setting impact absorbing load characteristics appropriately.

Further, as described below, the first embodiment makes it possible to reduce variations in the impact absorbing load caused by differences in the telescopic adjustment position during the second relative sliding. As illustrated in FIG. **3**, after the telescopic adjustment, when the clamping shaft **21** is located in the axial long hole **55** at a location close to the coupled portion **52**P of each extension portion **52**, the clamping mechanism **18** mainly clamps a first region A**1** of the extension portion **52** that includes the coupled portion **52**P and an area near the coupled portion **52**P.

In contrast, when the clamping shaft **21** is located in the axial long hole **55** at a location (i.e., at a location in proximity to the second defining section **62**) farthest from the location close to the coupled portion **52**P, the clamping mechanism **18** mainly clamps a second region A**2** of each extension portion **52** that includes the second defining section **62** and an area near the second defining section **62**. Assuming that there is no slit **54**, the amount of deflection of the first region A**1** in the lateral direction Z caused when the clamping mechanism **18** mainly clamps the first region A**1** is considerably smaller than the amount of deflection of the second region A**2** in the lateral direction Z caused when the clamping mechanism **18** mainly clamps the second region A**2**.

In contract, according to the first embodiment, the action of the slit **54** as the coupling stiffness reducing mechanism facilitates deflection of the coupled portion **52**P of the extension portion **52** (the first region A**1** including the coupled portion **52**P), relative to the fixed portion **51**, in the lateral direction Z as seen from the column axis direction X. Thus, a change in a clamped position where the extension portion **52** is clamped after the telescopic adjustment is less likely to cause a change in the deflection strength of the extension portion **52** in the lateral direction Z. Accordingly, the second resistive force G**2** generated during the secondary impact by the relative sliding of the second sliding member **50** is likely to remain unchanged, regardless of where the relative sliding occurs. This reduces variations in the impact absorbing load caused by differences in the telescopic adjustment position.

As described above, the change in the clamped position where the extension portion **52** is clamped after the telescopic adjustment is less likely to cause the change in the deflection strength of the extension portion **52** in the lateral direction Z. This also reduces variations in operating load of the operating lever **20** of the clamping mechanism **18**, caused by differences in the clamped position. Further, using the slit **54** extending in the column axis direction X as the coupling stiffness reducing mechanism makes it possible to reduce the coupling stiffness between the fixed portion **51** and the coupled portion **52**P of the extension portion **52** by a simple structure.

Further, each of the second sliding members **50** is held between the corresponding clamped portion **19** of the lower jacket **8** and the corresponding side plate **22** of the supporting member **17** clamped by the clamping mechanism **18**. Thus, during the first relative sliding, the first sliding member **40** moving together with the second sliding members **50** is suppressed from vibrating in a direction perpendicular to the direction of the first relative sliding. This stabilizes the impact absorbing load during the secondary impact.

FIG. **8** is a side view of the first sliding member **40** and second sliding members **50**Q of a steering apparatus according to a second embodiment of the invention. The second sliding members **50**Q according to the second embodiment illustrated in FIG. **8** differ mainly in the following aspect from the second sliding members **50** according to the first embodiment illustrated in FIG. **3**. In each of the second sliding members **50**Q, a slit **54** is separated upward from an extension portion **52** in the vertical direction V. The slit **54** is formed in a second coupling portion **532** of a coupling

portion **53**. According to the second embodiment, since there is a greater distance between the slit **54** and the clamping shaft **21** in the vertical direction V, a longer arm length (corresponding to the distance between the slit **54** and the clamping shaft **21**) is provided for a bending moment that has a fulcrum point near the slit **54** and that is applied when a first region A**1** of the extension portion **52** that includes a coupled portion **52**P is clamped after the telescopic adjustment. The amount of deflection of the first region A**1** in the lateral direction Z is increased accordingly.

This more effectively reduces the change in the deflection strength of the extension portion **52** in the lateral direction Z, relative to the change in the clamped position after the telescopic adjustment. Thus, the second resistive force G**2** generated during the secondary impact by the relative sliding of the second sliding members **50**Q is likely to remain unchanged, regardless of where the relative sliding occurs. This more effectively reduces variations in the impact absorbing load caused by differences in the telescopic adjustment position. Although not illustrated in the drawings, the slit **54** of the first embodiment illustrated in FIG. **3** and the second embodiment illustrated in FIG. **8** may be replaced with a concave groove that extends in the column axis direction X without penetrating the second sliding member **50** (**50**Q) in the lateral direction Z.

FIG. **9**A is a schematic side view of the first sliding member **40** and second sliding members **50**R of a steering apparatus according to a third embodiment of the invention. FIG. **9**B is a schematic plan view of the first sliding member **40** and the second sliding members **50**R. FIG. **9**C is a schematic plan view illustrating the main part of the first sliding member **40**, the second sliding members **50**R, and the clamping mechanism **18**.

The second sliding members **50**R according to the third embodiment illustrated in FIGS. **9**A and **9**B differ mainly in the following aspect from the second sliding members **50** according to the first embodiment illustrated in FIG. **3**. In each of the second sliding members **50**R, a coupling portion **53**R that couples a fixed portion **51** to a coupled portion **52**P of an extension portion **52** includes the following: a first coupling portion **531** coupled to the fixed portion **51** from the axial lower side XL; and a second coupling portion **532** that is interposed between the first coupling portion **531** and the extension portion **52** and that is coupled to the coupled portion **52**P of the extension portion **52** from above in the vertical direction V.

Each of the second sliding members **50**R further includes the coupling stiffness reducing mechanism an elastically deformable bent portion **57** that couples the fixed portion **51** to the coupled portion **52**P of the extension portion **52** and that undulates in the lateral direction Z as seen from the vertical direction V, as illustrated in FIG. **9**B. Specifically, the first coupling portion **531** includes the elastically deformable bent portion **57**, and the bent portion **57** has a rectangular C-shape that projects outward in the lateral direction Z. The bent portion **57** includes a plate-like first section **71**, a plate-like second section **72**, and a plate-like third section **73**. As illustrated in FIG. **9**B that is a diagram viewed from the vertical direction V, the first section **71** extends from the fixed portion **51** outward in the lateral direction Z as seen from the vertical direction V The second section **72** extends from the second coupling portion **532** outward in the lateral direction Z as seen from the vertical direction V. The third section **73** joins together the outer ends of the first section **71** and the second section **72** in the lateral direction Z. The first section **71** and the second section **72** are aligned parallel to the lateral direction Z. The third section **73** is perpendicular to the first section **71** and the second section **72**.

Each of the second sliding members **50** further includes a plate-like limiting portion **74** that extends from the first section **71** of the bent portion **57** toward the axial lower side XL. FIG. **9**D is an enlarged cross-sectional view of a structure around the bent portion **57**. As illustrated in FIG. **9**D, the limiting portion **74** includes a first end **741** and a second end **742**. The first end **741** is coupled to an edge **76***a* (the edge close to the fixed portion **51**) of an opening **76** in the first section **71**. The second end **742** is located in proximity to the second section **72**, but separated by a clearance S**1** from the second section **72**. The limiting portion **74** is cantilevered by the first section **71**. The limiting portion **74** may be cut in and bent from the first section **71**. The limiting portion **74** is aligned parallel to the third section **73** and is separated by a clearance S**2** from the third section **73** in the lateral direction Z.

As illustrated in FIG. **9**C, when the clamping mechanism **18** clamps the first region A**1** of the extension portion **52** that includes the coupled portion **52**P, the bent portion **57** (the coupling stiffness reducing mechanism) is elastically deformed such that an angle formed between the first section **71** and the third section **73** and an angle formed between the third section **73** and the second section **72** are changed. This allows the second coupling portion **532** and the coupled portion **52**P of the extension portion **52** that is coupled to the second coupling portion **532** to deflect more easily in the lateral direction Z.

The clearance S**1** between the limiting portion **74** and the second section **72** of the bent portion **57** and the clearance S**2** between the limiting portion **74** and the third section **73** of the bent portion **57**, so that the limiting portion **74** does not hinder elastic deformation of the bent portion **57** toward a clamping portion in the lateral direction Z. Although not illustrated in the drawings, during the secondary impact, the first section **71** and the second section **72** of the bent portion **57** approach each other by the width of the clearance S**1**, so that the second end **742** of the limiting portion **74** abuts against the second section **72** of the bent portion **57**. This abutment limits deformation of the bent portion **57** in the column axis direction X. As such, during the secondary impact, the limiting portion **74** limits, to a predetermined limit amount (the amount corresponding to the width of the clearance S**1**), the amount of deformation of the bent portion **57** in the column axis direction X.

The third embodiment uses the bent portion **57** that is elastically deformable in the lateral direction Z in the clamping state of the clamping mechanism **18**, thus making it possible to reduce the coupling stiffness between the fixed portion **51** and the coupled portion **52**P of the extension portion **52** by a simple structure. This reduces variations in the impact absorbing load caused by differences in the telescopic adjustment position, as in the first embodiment. Further, during the secondary impact, the limiting portion **74** limits the amount of deformation of the bent portion **57** in the column axis direction. During the secondary impact before the deformation of the bent portion **57** is limited by the limiting portion **74** (i.e., in a deformation load generation phase prior to the start of the second relative sliding phase in FIG. **10**), the sum (F+H) of a column resistive force F caused by frictional sliding of the upper jacket **7** on the lower jacket **8** and a deformation load H of the bent portion **57** in the column axis direction X is used as the impact absorbing load.

During the secondary impact after the deformation of the bent portion **57** is limited by the limiting portion **74** (i.e., after the start of the second relative sliding phase), the sum (F+G**2**) of the column resistive force F and the second resistive force G**2** generated by the second relative sliding of the extension portions **52** of the second sliding members **50**R on the supporting member **17** and the lower jacket **8** is used as the impact absorbing load. Setting the limit amount appropriately allows setting impact absorbing characteristics appropriately in accordance with the axial displacement of the upper jacket **7** relative to the lower jacket **8**.

Next, a fourth embodiment is described. FIGS. **11**B and **11**B are schematic diagrams illustrating a structure around a bent portion **57** according to the fourth embodiment. FIG. **11**A illustrates a state after the telescopic adjustment. FIG. **11**B is a state where deformation of the bent portion **57** in the column axis direction X is limited to a predetermined limit amount during the secondary impact. The fourth embodiment differs from the third embodiment mainly in that a base end **71***a* of a first section **71** and a base end **72***a* of a second section **72** abut against each other during the secondary impact, so that deformation of the bent portion **57** in the column axis direction X is limited to the limit amount (corresponding to the width of a clearance S**3** between the first section **71** and the second section **72** in the column axis direction X).

Thus, according to the fourth embodiment, the base end **71***a* of the first section **71** and the base end **72***a* of the second section **72** form a limiting portion that limits, to the limit amount, deformation of the bent portion **57** in the column axis direction X during the secondary impact. As such, the limiting portion according to the fourth embodiment has a simpler structure. In the third embodiment illustrated in FIG. **9**A, both the slit **54** and the bent portion **57** are used as the coupling stiffness reducing mechanism. Alternatively, as in a fifth embodiment illustrated in FIG. **12**, only the bent portion **57** may be used as the coupling stiffness reducing mechanism.

FIGS. **13**A, **13**B, and **13**C are schematic plan views illustrating the main part of a first sliding member, second sliding members, and a clamping mechanism of steering apparatuses according to sixth, seventh, and eighth embodiments of the invention, respectively. FIGS. **13**A, **13**B, and **13**C illustrate modifications of a bent portion. As illustrated in FIG. **13**A, in each of second sliding members **50**V according to the sixth embodiment, a first coupling portion **531** of a coupling portion **53**V includes an elastically deformable bent portion **57**V having a V-shape that projects outward in the lateral direction Z as seen from the vertical direction V. The bent portion **57**V has a pair of plate-like sections **81** and **82**. The plate-like sections **81** and **82** are joined at a predetermined angle and are inclined oppositely to each other relative to the lateral direction Z as seen from the vertical direction V. The plate-like sections **81** and **82** cause the bent portion **57**V to undulate in the lateral direction Z.

As illustrated in FIG. **13**B, in each of second sliding members **50**W according to the seventh embodiment, a first coupling portion **531** of a coupling portion **53**W includes an elastically deformable bent portion **57**W having a W-shape that projects outward in the lateral direction Z as seen from the vertical direction V. The bent portion **57**W has two pairs of plate-like sections **83** and **84**. In each of the two pairs, the plate-like sections **83** and **84** are joined at a predetermined angle and are inclined oppositely to each other relative to the lateral direction Z as seen from the vertical direction V. The two pairs of plate-like sections **83** and **84** cause the bent portion **57**W to undulate in the lateral direction Z.

As illustrated in FIG. **13**C, in each of second sliding members **50**U according to the eighth embodiment, a first coupling portion **531** of a coupling portion **53**U includes an elastically deformable curved portion **57**U having a U-shape that projects outward in the lateral direction Z as seen from the vertical direction V The curved portion **57**U includes: a pair of sections **91** and **92** that extend parallel to the lateral direction Z and that are spaced from each other in the column axis direction X; and a curved section **93** that joins together the sections **91** and **92**.

The sixth and seventh embodiments use the bent portions **57**V and **57**W, respectively, that are elastically deformable in the lateral direction Z in the clamping state of the clamping mechanism **18**, thus making it possible to reduce the coupling stiffness between the fixed portion **51** and the coupled portion **52**P of the extension portion **52** by a simple structure. The eighth embodiment uses the curved portion **57**U that is elastically deformable in the lateral direction Z in the clamping state of the clamping mechanism **18**, thus making it possible to reduce the coupling stiffness between the fixed portion **51** and the coupled portion **52**P of the extension portion **52** by a simple structure. This reduces variations in the impact absorbing load caused by differences in the telescopic adjustment position, as in the first embodiment.

Although not illustrated in the drawings, according to the sixth embodiment, sections (these sections form a limiting portion) that include at least base ends **81***a* and **82***a* of the pair of sections **81** and **82** of the bent portion **57**V abut against each other during the secondary impact, so that deformation of the bent portion **57**V in the column axis direction X is limited to the limit amount. Although not illustrated in the drawings, according to the seventh embodiment, sections (these sections form a limiting portion) that include at least base ends **83***a* and **84***a* of each of the two pairs of sections **83** and **84** of the bent portion **57**W abut against each other during the secondary impact, so that deformation of the bent portion **57**W in the column axis direction X is limited to the limit amount.

Although not illustrated in the drawings, according to the eighth embodiment, sections (these sections form a limiting portion) that include at least base ends **91***a* and **92***a* of the pair of sections **91** and **92** of the curved portion **57**U abut against each other during the secondary impact, so that deformation of the curved portion **57**U in the column axis direction X is limited to the limit amount. According to the sixth, seventh, and eighth embodiments, during the secondary impact before the deformation is limited by the limiting portion, a deformation load of each of the bent portions **57**V and **57**W and the curved portion **57**U is used as the impact absorbing load. In contrast, during the secondary impact after the deformation is limited by the limiting portion, a sliding load generated by relative sliding of the extension portion **52** of each of the second sliding members **50**V, **50**W, and **50**U on the supporting member **17** and the lower jacket **8** is used as the impact absorbing load.

Although not illustrated in the drawings, a limiting portion having the same structure as the limiting portion **74** according to the third embodiment illustrated in FIG. **9**D may be added to one of the paired sections **81** and **82** according to the sixth embodiment, one of the paired sections **83** and **84** according to the seventh embodiment, and one of the paired sections **91** and **92** according to the eighth embodiment. The invention is not limited to the embodiments described above and may be modified in various ways. A ninth embodiment of the invention as one example

of modifications will be described below. According to the ninth embodiment, as illustrated in FIG. **14**, the second resistive force G**2** is set greater than the first resistive force G**1** (G**1**<G**2**). When the facing member **101** as a stopper abuts against the first sliding member **40** during the secondary impact after the start of the first relative sliding, the movement of the first sliding member **40** and the second sliding members **50**, relative to the upper jacket **7**, toward the axial lower side XL is limited. Thus, the first relative sliding is stopped, and the stop of the first relative sliding starts the second relative sliding. The structure of the ninth embodiment that sets the second resistive force G**2** greater than the first resistive force G**1** (G**1**<G**2**) is applicable to any of the first to eighth embodiments.

The rectangular C-shaped bent portion **57** of the second sliding member **50**R according to the third embodiment of FIGS. **9**A to **9**D and according to the fourth embodiment of FIG. **11**A, the V-shaped bent portion **57**V of the second sliding member **50**V according to the fourth embodiment of FIG. **11**A, the W-shaped bent portion **57**W of the second sliding member **50**W according to the seventh embodiment of FIG. **13**B, and the U-shaped curved portion **57**U of the second sliding member **50**U according to the eighth embodiment of FIG. **13**C may be respectively made of a different material from the material of the portions of the second sliding members **50**R, **50**V, **50**W, and **50**U other than the bent portions **57**, **57**V, **57**W, and **57**U (for example, a material that is easier to be elastically deformed than that of the other portions).

At least two of the C-shaped bent portion **57** according to the fourth embodiment of FIG. **11**A, the V-shaped bent portion **57**V according to the sixth embodiment of FIG. **13**A, the W-shaped bent portion **57**W according to the seventh embodiment of FIG. **13**B, and the U-shaped curved portion **57**U according to the eighth embodiment of FIG. **13**C may be arranged in the column axis direction X. Although not illustrated in the drawings, each of the second sliding members **50** may be located between the corresponding side plate **22** of the supporting member **17** and the corresponding one of the clamping members **32** and **33**.

What is claimed is:

1. A steering apparatus comprising:

an upper jacket having a first end in a column axis direction, the first end being coupled to a steering member;

a lower jacket slidably fitted externally on a second end of the upper jacket in the column axis direction;

a supporting member that is fixed to a vehicle body and that supports the lower jacket;

a clamping mechanism that holds the upper jacket in a position relative to the lower jacket by clamping the lower jacket to the upper jacket;

a holding member held by the upper jacket; and

a resistive force generating mechanism that is movable together with the holding member in the column axis direction and that slides, when the upper jacket moves relative to the lower jacket during a secondary impact, relative to at least one of the supporting member and the lower jacket so as to generate a resistive force against movement of the upper jacket, wherein

the resistive force generating mechanism includes a fixed portion fixed to the holding member, and an extension portion extending in the column axis direction and having a coupled portion that is coupled to the fixed portion at a predetermined location in the column axis direction,

the clamping mechanism clamps the lower jacket to the upper jacket via the supporting member and the extension portion, and

the resistive force generating mechanism further includes a coupling stiffness reducing mechanism that reduces coupling stiffness between the fixed portion and the coupled portion of the extension portion so as to facilitate, when the clamping mechanism clamps the lower jacket to the upper jacket, deflection of the coupled portion of the extension portion relative to the fixed portion in a lateral direction as seen from the column axis direction.

2. The steering apparatus according to claim **1**, wherein

the coupling stiffness reducing mechanism includes a slit or concave groove that extends in the column axis direction and that is located adjacent to or separated from the extension portion in a vertical direction.

3. The steering apparatus according to claim **1**, wherein

the coupling stiffness reducing mechanism includes an elastically deformable bent portion or curved portion that couples the fixed portion to the coupled portion of the extension portion and that undulates in the lateral direction as seen from a vertical direction.

4. The steering apparatus according to claim **3**, wherein

the resistive force generating mechanism includes a limiting portion that limits, to a predetermined limit amount, an amount of deformation of the bent portion or curved portion in the column axis direction during the secondary impact.

5. The steering apparatus according to claim **1**, wherein

the holding member serves as a first resistive force generating mechanism that generates a first resistive force against the movement of the upper jacket in first relative sliding between the holding member and the upper jacket during the secondary impact, and

the resistive force generating mechanism including the extension portion serves as a second resistive force generating mechanism that generates a second resistive force against the movement of the upper jacket in second relative sliding between the resistive force generating mechanism and at least one of the supporting member and the lower jacket during the secondary impact.

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