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(54) CIRCUIT BREAKER

SCHUTZSCHALTER

COUPE-CIRCUIT

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Description

TECHNICAL FIELD

[0001] The present invention relates to a circuit breaker having a thermal tripping device for tripping an open/close mechanism portion by driving a trip bar by a bimetal which bends when overcurrent occurs on an electric path.

BACKGROUND ART

[0002] A conventional circuit breaker adapted to an electric path containing a harmonic component employs a thermal tripping device. Generally, the thermal tripping device is configured to drive a trip bar by a bimetal which bends and deforms when overcurrent occurs on an electric path, thereby tripping an open/close mechanism portion.

[0003] For enhancing the breaking capacity of such a circuit breaker, particularly in a product with low rating (for example, 30A or lower) which needs to satisfy operation within two minutes prescribed in Electrical Appliance and Material Safety Act, current is directly applied to the bimetal so that the operation within two minutes is satisfied (for example, see Patent Document 1).

[0004] However, there are such problems that, when short-circuit current upon short circuit passes through the bimetal, the bimetal is fused or the bimetal is permanently deformed.

[0005] For preventing this, a circuit breaker is known which has an extended plate provided at a head end of a bimetal (for example, see Patent Document 2).

CITATION LIST

PATENT DOCUMENT

[0006]

Patent Document 1: Japanese Laid-Open Patent Publication No. 2008-153072
Patent Document 2: Japanese Laid-Open Patent Publication No. 2010-218765

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0007] In the case of further enhancing the breaking capacity in the conventional circuit breaker configured as described above, increase in the current passing upon breaking has a great influence on tripping operation time delay after the breaking due to permanent deformation of the bimetal.

[0008] The reason is as follows. The trip bar connecting the open/close mechanism portion and the thermal tripping device has a stopper position spaced by a certain stroke after tripping of the open/close mechanism portion, and therefore the bimetal upon breaking is held at the stopper position, thereby causing permanent deformation.

[0009] Therefore, after the breaking, the distance between the trip bar and the bimetal increases due to the permanent deformation, leading to tripping operation time delay.

[0010] In the case of attempting to solve the above problem by means other than a thermal tripping device, for the purpose of extending the arc length on an arc extinguishing device side, expansion of the outer shape, expansion of a contact separation distance, and reduction of a contact opening start time and an opening time may be conducted, or a measure such as current limiting performance improvement by, for example, narrowing the arc diameter by pressure increase, or employment of a tripping device that does not pass current through the bimetal upon large current breaking, may be taken. However, in such cases, it becomes difficult to maintain the present outer dimension or realize size reduction. In addition, needless to say, there is disadvantage in terms of cost.

[0011] In addition, in the configuration in which the extended plate is provided as shown in Patent Document 2, in order to satisfy an initial stable thermal tripping characteristic, generally, bending of the extended plate corresponding to a tripping load needs to be suppressed to be equal to or smaller than 0.5 mm.

[0012] Therefore, in order to cause a load corresponding to the tripping load by using this extended plate within the bending amount of 0.5 mm, the extended plate needs to be formed by a plate material having a considerably high spring constant.

[0013] As a result, this extended plate needs a plate material having a rigidity equal to that of the bimetal, and a bending amount of the bimetal upon breaking is directly transmitted to the bimetal. Therefore, it is difficult to prevent permanent deformation.

[0014] An object of the present invention is to, without great modification of the conventional outer shape and structure, provide a circuit breaker having a thermal tripping device which can realize stable operation without change in tripping time between before and after breaking.

SOLUTION TO THE PROBLEMS

[0015] The present invention is a circuit breaker including: an open/close mechanism portion for driving open/close contacts to open or close an electric path; an electromagnetic tripping device for driving a trip bar to trip the open/close mechanism portion, when overcurrent flows on the electric path; and a thermal tripping device for driving the trip bar by a bimetal which bends when overcurrent flows on the electric path, to trip the open/close mechanism portion. The thermal tripping device includes: a bimetal upper base fixed on a head end

of the bimetal; a bimetal upper rotatably provided on the bimetal upper base and fixed to an overcurrent characteristic adjustment member opposing to the trip bar via a predetermined gap therebetween; and a bimetal upper spring held by the bimetal upper base and constantly energizing the bimetal upper by a load equal to or greater than a tripping load of the open/close mechanism portion. When overcurrent flows on the electric path, the bimetal upper is rotated against the bimetal upper spring by bending of the bimetal, and thereby the trip bar is driven via the overcurrent characteristic adjustment member.

EFFECT OF THE INVENTION

[0016] The present invention makes it possible to, without great modification of the conventional outer shape and structure and with the minimum number of additional components, realize a thermal tripping device which can perform stable operation without change in tripping time between before and after breaking, and easily obtain a small-size circuit breaker that is adaptable to harmonic and has a high breaking capacity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

[FIG. 1] FIG. 1 is a vertical sectional view showing the entirety of a circuit breaker according to embodiment 1 of the present invention.

[FIG. 2] FIG. 2 is an enlarged side view showing a tripping device in FIG. 1.

[FIG. 3] FIG. 3 is an enlarged perspective view showing a major part of a thermal tripping device in FIG. 2.

[FIG. 4] FIG. 4 is a vertical sectional view showing the entirety of the circuit breaker upon breaking, according to embodiment 1.

[FIG. 5] FIG. 5 is an enlarged side view showing the tripping device in FIG. 4.

[FIG. 6] FIG. 6 is an enlarged side view showing a bent state of a bimetal in the thermal tripping device in FIG. 4.

[FIG. 7] FIG. 7 is an explanation diagram showing a load characteristic of a bimetal upper of the thermal tripping device according to embodiment 1 as compared to that in a conventional structure.

[FIG. 8] FIG. 8 is an enlarged perspective view showing a major part of a thermal tripping device according to embodiment 2 of the present invention.

[FIG. 9] FIG. 9 is an enlarged side view showing a tripping device at the maximum trip position according to embodiment 2.

DESCRIPTION OF EMBODIMENTS

Embodiment 1

[0018] First, with reference to the drawings, the schematic structure of a circuit breaker according to embodiment 1 of the present invention will be described.

[0019] In FIG. 1, a circuit breaker 100 is formed using a housing 1 composed of a base 2 and a cover 3 which are formed by an insulation material.

[0020] On the base 2, circuit breaking units for respective phases whose number is equal to a pole number (for example, in the case of three phases, three circuit breaking units) are disposed in parallel with each other. Above the center circuit breaking unit, an open/close mechanism portion 20 having a known toggle link mechanism is disposed.

[0021] The cover 3 covers the circuit breaking units for respective phases on the base 2, and the open/close mechanism portion 20. An operation handle 21 of the open/close mechanism portion 20 protrudes from the cover 3.

[0022] The circuit breaking units for respective phases have the same configuration. A cross bar 10 is disposed on the base 2 so as to cross the circuit breaking units for respective phases and be perpendicular to the circuit breaking units for respective phases,

[0023] The circuit breaking units for respective phases each have: a power-supply-side terminal 7 provided on the base 2; a fixed contact 4 provided so as to extend from the power-supply-side terminal 7; a movable contact 5 to contact with or be separated from the fixed contact 4; a movable contactor 6 rotatably held by the cross bar 10, with the movable contact 5 being provided at one end of the movable contactor 6; a tripping device 30 connected to the movable contactor 6 via a movable element holder 9; and a load-side terminal 8 connected to the tripping device 30 and provided on the base 2. The fixed contact 4 and the movable contact 5 compose open/close contacts for opening or closing an electric path.

[0024] When the movable contact 5 contacts with the fixed contact 4, an electric circuit between the power-supply-side terminal 7 and the load-side terminal 8 is turned on. When the movable contact 5 is separated from the fixed contact 4, the electric circuit between the power-supply-side terminal 7 and the load-side terminal 8 is turned off.

[0025] The cross bar 10 is disposed at a bottom portion of the base 2, and extends perpendicularly to the drawing surface of FIG. 1. The cross bar 10 is rotated about the axis thereof by the open/close mechanism portion 20. The movable contactors 6 of the circuit breaking units for respective phases are attached to the cross bar 10.

[0026] When the cross bar 10 is rotated about the axis thereof, the movable contactors 6 of the circuit breaking units for respective phases are simultaneously rotated, and the rotation of the movable contactor 6 causes the movable contact 5 to contact with or to be separated from the fixed contact 4.

[0027] The open/close mechanism portion 20 is formed by a known toggle link mechanism, and has a known trip bar 22 which is driven by the tripping device 30, and a trip bar stopper 23 which locks the trip bar 22

at the maximum trip position.

[0028] An arc extinguishing chamber 11 is disposed near the movable contactor 6, and extinguishes an arc caused between the movable contact 5 and the fixed contact 4 upon operation of the open/close mechanism portion 20.

[0029] The tripping device 30 is composed of an electromagnetic tripping device 40 and a thermal tripping device 50 as shown in FIG. 2.

[0030] The electromagnetic tripping device 40 has: a fixed iron core 41; a movable iron core 42 which is to be adhered to the fixed iron core 41 upon instantaneous breaking, to drive the trip bar 22; a return spring 43 energizing the movable iron core 42; and a shaft 44 pivotably supporting the movable iron core 42.

[0031] FIG. 3(a) and FIG. 3(b) are enlarged perspective views of a major part of the thermal tripping device 50 as seen from respective directions opposite to each other. The thermal tripping device 50 has: a bimetal 51 having a lower end fixedly connected to the movable element holder 9; a bimetal upper base 52 fixed on a head end of the bimetal 51; a bimetal upper 54 pivotably supported by the bimetal upper base 52 with a rotary shaft 53 used as a pivot, with an overcurrent characteristic adjustment screw 57 being screwed into the bimetal upper 54; and a bimetal upper spring 56 held by the bimetal upper base 52 and energizing the bimetal upper 54 toward the trip bar 22, for giving a movable load.

[0032] The bimetal upper 54 is constantly energized by the bimetal upper spring 56 while contacting with a bimetal upper stopper 55 provided on the bimetal upper base 52. A spring load on the bimetal upper 54 is set to be greater than a tripping load, at an abutting position of the trip bar 22.

[0033] An electric conduction connection member 58 is fixed at an upper end of the bimetal 51 by a rivet 60. The bimetal 51 is connected to the load-side terminal 8 via the electric conduction connection member 58 and a flexible conductor 59 so that current of the electric path can flow therethrough.

[0034] In FIG. 3, an example where the bimetal upper base 52 is integrally formed with the electric conduction connection member 58, has been shown. However, the bimetal upper base 52 and the electric conduction connection member 58 may be separately formed and then may be fixed with each other by welding or the like.

[0035] Next, a breaking operation of the circuit breaker 100 will be described.

[0036] When overcurrent equal to or greater than predetermined current flows in the bimetal 51, the bimetal 51 itself generates heat, and the bimetal 51 is deformed to be bent by the heat generation.

[0037] Since the overcurrent characteristic adjustment screw 57 is fixed to the bimetal 51 via the bimetal upper 54 and the bimetal upper base 52, when the bimetal 51 has been bent, the overcurrent characteristic adjustment screw 57 pushes the trip bar 22, whereby the open/close mechanism portion 20 is driven to rotate the movable contactor 6. By the rotation of the movable contactor 6, the movable contact 5 is separated from the fixed contact 4, whereby the operation of current breaking is completed (see FIGS. 4 to 6).

[0038] It is noted that FIG. 4 shows the state where the thermal tripping device 50 has just operated, and in this state, the movable contact 5 is still in contact with the fixed contact 4.

[0039] When the above-described overcurrent characteristic adjustment screw 57 pushes the trip bar 22, the bimetal upper 54 is constantly energized toward the trip bar 22 by the bimetal upper spring 56 while contacting with the bimetal upper stopper 55 provided on the bimetal upper base 52.

[0040] In this case, since a spring load on the bimetal upper 54 is set to be greater than a tripping load at the abutting position of the trip bar 22, the bimetal upper 54 can push the trip bar 22 without rotating.

[0041] FIG. 7 is an explanation diagram showing a load characteristic of the bimetal upper 54 of the thermal tripping device 50 as compared to that in the conventional structure. The spring load on the bimetal upper 54 is set to be greater than the tripping load, at the abutting position of the trip bar 22, and also, is set to be smaller than a spring load on the extended plate in the conventional structure, at the lock position of the trip bar 22.

[0042] Therefore, at the abutting position of the trip bar 22, the bimetal upper 54 can push the trip bar 22 without rotating, and also, in the state where the trip bar 22 is driven and thereby the open/close mechanism portion 20 is tripped, the bimetal upper spring 56 bends in accordance with a load applied to the bimetal upper 54.

[0043] When overcurrent such as short-circuit current flows, the movable iron core 42 is adhered to the fixed iron core 41 owing to magnetic force generated in the fixed iron core 41 of the electromagnetic tripping device 40, whereby the movable iron core 42 rotates about the shaft 44 as a pivot against energizing force of the return spring 43.

[0044] The rotation causes the movable iron core 42 to push the trip bar 22, whereby the open/close mechanism portion 20 is driven to rotate the movable contactor 6.

[0045] The rotation of the movable contactor 6 causes the movable contact 5 to be separated from the fixed contact 4, whereby the overcurrent is interrupted and the trip operation is completed.

[0046] However, also when overcurrent such as short-circuit current flows, the bimetal 51 is bent. The bending stroke is equal to or greater than a stroke for the trip bar 22 to abut the trip bar stopper 23 of the open/close mechanism portion 20.

[0047] Therefore, the bimetal upper 54 rotates. Since a load equal to or greater than the spring load characteristic of the bimetal upper spring 56 is applied to the bimetal upper 54, the bimetal upper spring 56 is bent, so that the bimetal upper 54 rotates.

[0048] Thus, since the bimetal upper 54 rotates, a load

equal to or greater than the spring load characteristic of the bimetal upper spring 56 is eventually not applied to the bimetal 51.

[0049] In conventional case, the bending stroke of the bimetal 51 is forcibly fixed by the trip bar stopper 23 of the open/close mechanism portion 20 and thereby permanently deformed. However, in the present embodiment, when a load applied to the bimetal 51 becomes equal to or greater than the spring load characteristic of the bimetal upper spring 56, the bimetal upper spring 56 is bent and the bimetal upper 54 rotates, whereby permanent deformation of the bimetal 51 can be prevented.

[0050] Thus, it becomes possible to obtain a circuit breaker capable of stable tripping without change in a tripping time between before and after breaking.

Embodiment 2

[0051] FIG. 8(a) and FIG. 8(b) are enlarged perspective views of a major part of the thermal tripping device 50 as seen from respective directions opposite to each other. FIG. 9 is an enlarged side view showing a tripping device at the maximum trip position, according to embodiment 2.

[0052] Embodiment 2 uses a bimetal upper spring 61 formed by a compression spring instead of the bimetal upper spring 56 formed by a torsion spring in embodiment 1. The other configuration is the same as in embodiment 1, so the description thereof is omitted.

[0053] It is noted that although embodiment 2 uses a compression spring as the bimetal upper spring, a tension spring or the like may be used, which can obtain the same effect.

DESCRIPTION OF THE REFERENCE CHARACTERS

[0054]

100	circuit breaker
1	housing
2	base
3	cover
4	fixed contact
5	movable contact
6	movable contactor, movable element
7	power-supply-side terminal
8	load-side terminal
9	movable element holder
10	cross bar
11	arc extinguishing chamber
20	open/close mechanism portion
21	operation handle
22	trip bar
23	trip bar stopper
30	tripping device
40	electromagnetic tripping device
41	fixed iron core
42	movable iron core
43	return spring
44	shaft
50	thermal tripping device
51	bimetal
52	bimetal upper base
53	rotary shaft
54	bimetal upper
55	bimetal upper stopper
56	bimetal upper spring
57	overcurrent characteristic adjustment screw
58	electric conduction connection member
59	flexible conductor
60	rivet
61	bimetal upper spring

Claims

1. A circuit breaker comprising:

an open/close mechanism portion(20) for driving open/close contacts to open or close an electric path;
an electromagnetic tripping device (40) for driving a trip bar (22) to trip the open/close mechanism portion (20), when overcurrent flows on the electric path; and
a thermal tripping device (50) for driving the trip bar(22) by a bimetal(51) which bends when overcurrent flows on the electric path, to trip the open/close mechanism portion(20), wherein

the thermal tripping device(50) includes:

a bimetal upper base (52) fixed on a head end of the bimetal(51);
an overcurrent characteristic adjustment member(57) opposing to the trip bar(22) via a predetermined gap therebetween;

characterised in that a bimetal upper (54) is rotably provided on the bimetal upper base (52) and fixed to the overcurrent characteristic adjustment member (57) and
a bimetal upper spring (56) held by the bimetal upper base (52) and constantly energizing the bimetal upper (54) by a load equal to or greater than a tripping load of the open/close mechanism portion (20), and when overcurrent flows on the electric path, the bimetal upper (54) is rotated against the bimetal upper spring (56) by bending of the bimetal (51), and thereby the trip bar (22) is driven via the overcurrent characteristic adjustment member(57).

2. The circuit breaker according to claim 1, wherein in a state where the trip bar (22) is driven and the open/close mechanism portion (20) is tripped, the bimetal upper spring (56) is bent in accordance with

a load applied to the bimetal upper(54).

3. The circuit breaker according to claim 1 or 2, wherein the bimetal upper spring (56) is a torsion spring, a compression spring, or a tension spring.

Patentansprüche

1. Schutzschalter, umfassend:

einen Öffnungs-/Schließmechanismus-Abschnitt (20), zum Antreiben von Öffnungs-/Schließkontakten, um einen elektrischen Pfad zu öffnen oder zu schließen;
eine elektromagnetische Auslösevorrichtung (40), zum Antreiben einer Auslösestange (22) zum Auslösen des Öffnungs-/Schließmechanismus-Abschnitts (20), wenn ein Überstrom auf dem elektrischen Pfad fließt; und
eine thermische Auslöseeinrichtung (50), zum Antreiben der Auslösestange (22) durch ein Bimetall (51), das sich biegt, wenn ein Überstrom auf dem elektrischen Pfad fließt, um den Öffnungs-/Schließmechanismus-Abschnitt (20) auszulösen, wobei die thermische Auslöseeinrichtung (50) aufweist:

eine Bimetall-Oberbasis (52), die an einem Kopfende des Bimetalls (51) befestigt ist;
ein Überstromcharakteristik-Einstellelement (57), das der Auslösestange (22) mit einem vorbestimmten Spalt dazwischen gegenüberliegt;
dadurch gekennzeichnet, dass ein Bimetall-Oberteil (54) drehbar an der Bimetall-Oberbasis (52) vorgesehen ist und an dem Überstromcharakteristik-Einstellelement (57) befestigt ist, und
eine Bimetall-Oberfeder (56), die durch die Bimetall-Oberbasis (52) gehalten ist und konstant das Bimetall-Oberteil (54) mit einer Last erregt, die gleich oder größer ist als eine Auslöselast des Öffnungs-/Schließmechanismus-Abschnitts (20), und

wenn ein Überstrom auf dem elektrischen Pfad fließt, das Bimetall-Oberteil (54) durch das Biegen des Bimetalls (51) gegen die Bimetall-Oberfeder (56) gedreht wird, und damit die Auslösestange (22) anhand des Überstromcharakteristik-Einstellglied (57) angetrieben wird.

2. Die Unterbrechungsschaltung nach Anspruch 1, wobei in einem Zustand, in dem die Auslösestange (22) angetrieben wird, und der Öffnungs-/Schließmechanismus-Abschnitt (20) ausgelöst wird, die Bimetall-Oberfeder (56) gemäß einer Last gebogen wird, die auf das Bimetall-Oberteil (54) aufgebracht wird.

3. Schutzschalter nach Anspruch 1 oder 2, wobei die Bimetall-Oberfeder (56) eine Torsionsfeder, eine Druckfeder oder eine Zugfeder ist.

Revendications

1. Coupe-circuit comprenant:

une partie de mécanisme d'ouverture et de fermeture (20) pour l'entraînement de contacts d'ouverture et de fermeture pour ouvrir ou fermer une voie électrique ;
un dispositif de déclenchement électromagnétique (40) pour l'entraînement d'une barre de déclenchement (22) pour déclencher la partie de mécanisme d'ouverture et de fermeture (20) lorsqu'une surintensité passe sur la voie électrique ; et
un dispositif de déclenchement thermique (50) pour l'entraînement de la barre de déclenchement (22) par un bimétal (51) qui fléchit lorsqu'une surintensité passe sur la voie électrique, pour déclencher la partie de mécanisme d'ouverture et de fermeture (20), dans lequel :

le dispositif de déclenchement thermique (50) comporte:

une base de bimétal supérieur (52) fixée sur une extrémité de tête du bimétal (51);
un élément d'ajustement de caractéristique de surintensité (57) faisant face à la barre de déclenchement (22) via un intervalle prédéterminé entre eux ;
caractérisé en ce qu'un bimétal supérieur (54) est monté de manière à pouvoir tourner sur la base de bimétal supérieur (52) et fixé à l'élément d'ajustement de caractéristique de surintensité (57) et
un ressort de bimétal supérieur (56) maintenu par la base de bimétal supérieur (52) et excitant constamment le bimétal supérieur (54) par une charge égale ou supérieure à une charge de déclenchement de la partie de mécanisme d'ouverture et de fermeture (20) et, lorsque la surintensité passe sur la voie électrique, le bimétal supérieur (54) est soumis à une rotation à l'encontre du ressort de bimétal supérieur (56) par pliage du bimétal (51) et ainsi la barre de déclenchement (22) est en-

traînée via l'élément d'ajustement de caractéristique de surintensité (57).

2. Coupe-circuit selon la revendication 1, dans lequel, dans un état dans lequel la barre de déclenchement (22) est entraînée et la partie de mécanisme d'ouverture et de fermeture (20) est déclenchée, le ressort de bimétal supérieur (56) est fléchi en raison d'une charge appliquée au bimétal supérieur (54).

3. Coupe-circuit selon la revendication 1 ou 2, dans lequel le ressort de bimétal supérieur (56) est un ressort de torsion, un ressort de compression ou un ressort de tension.

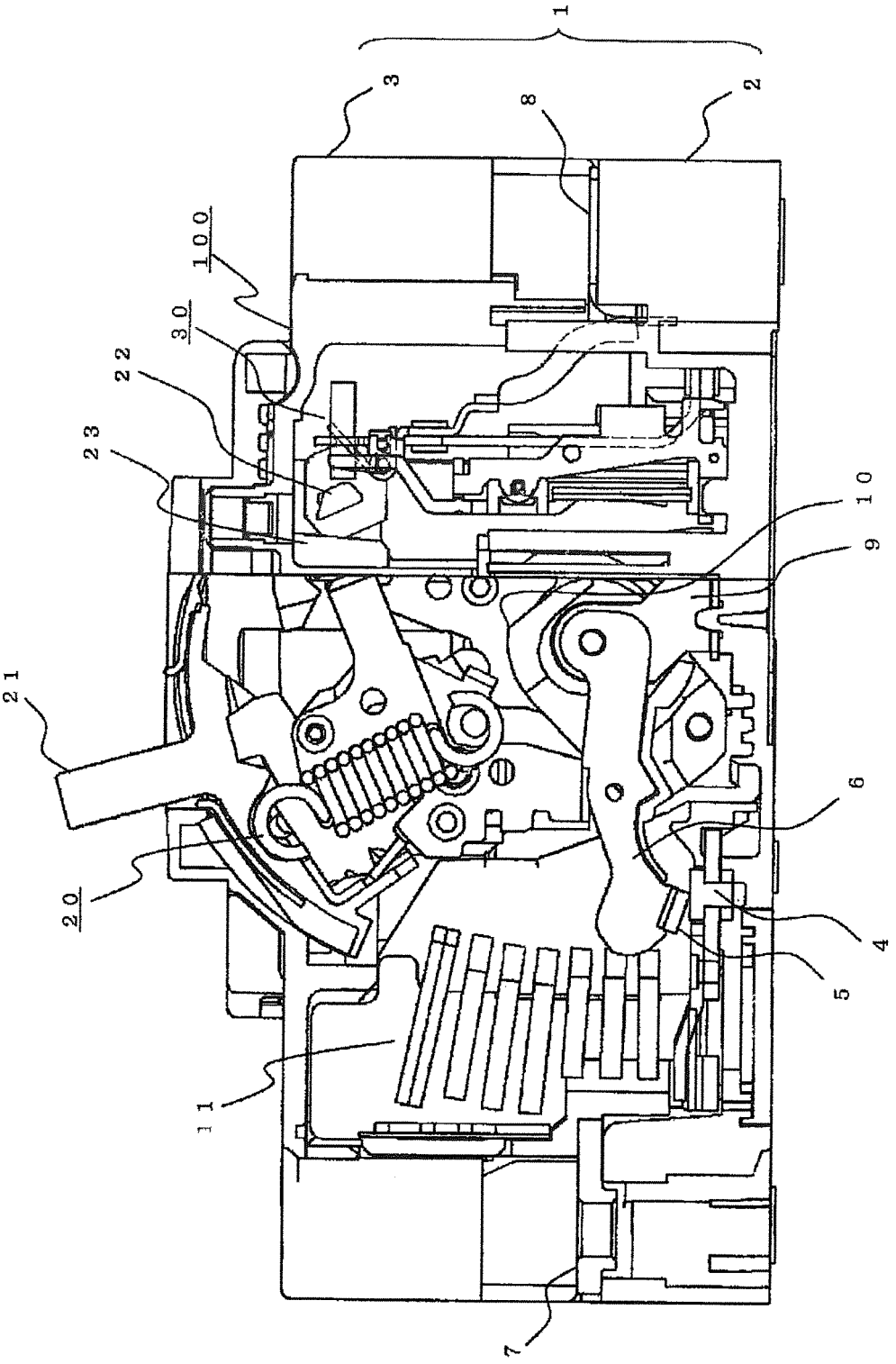


FIG. 1

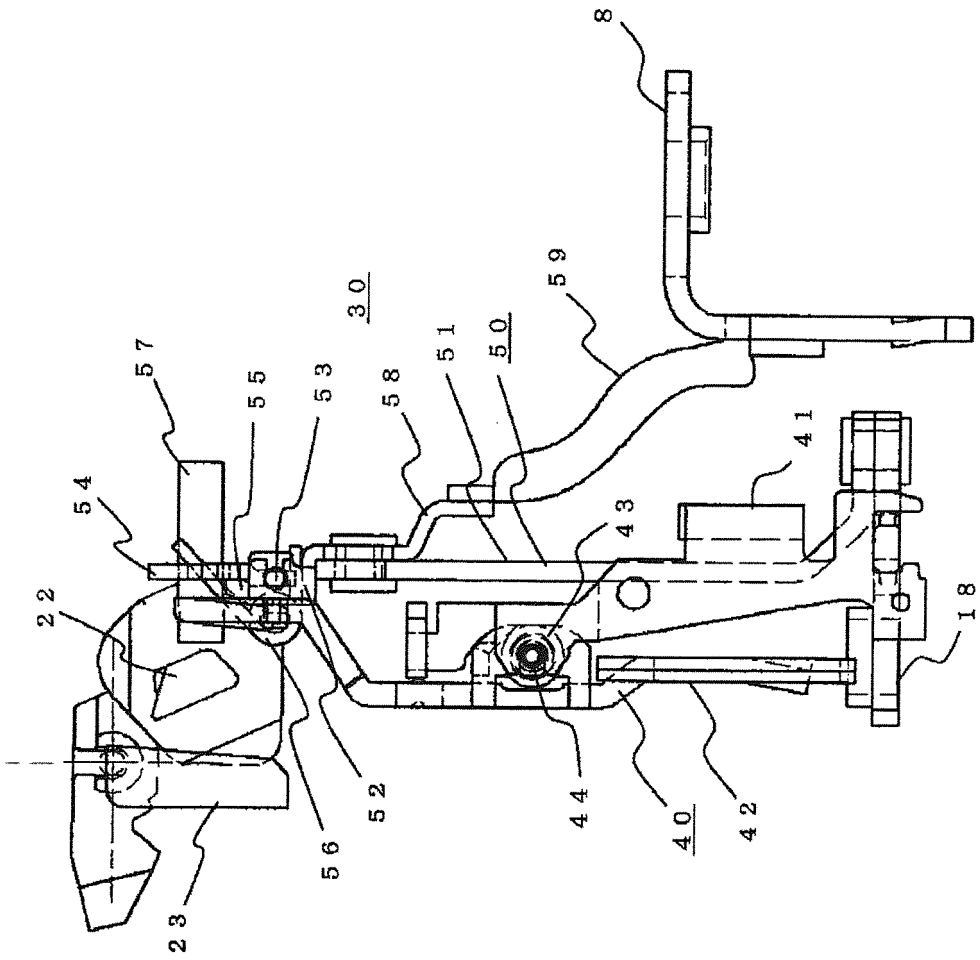


FIG. 2

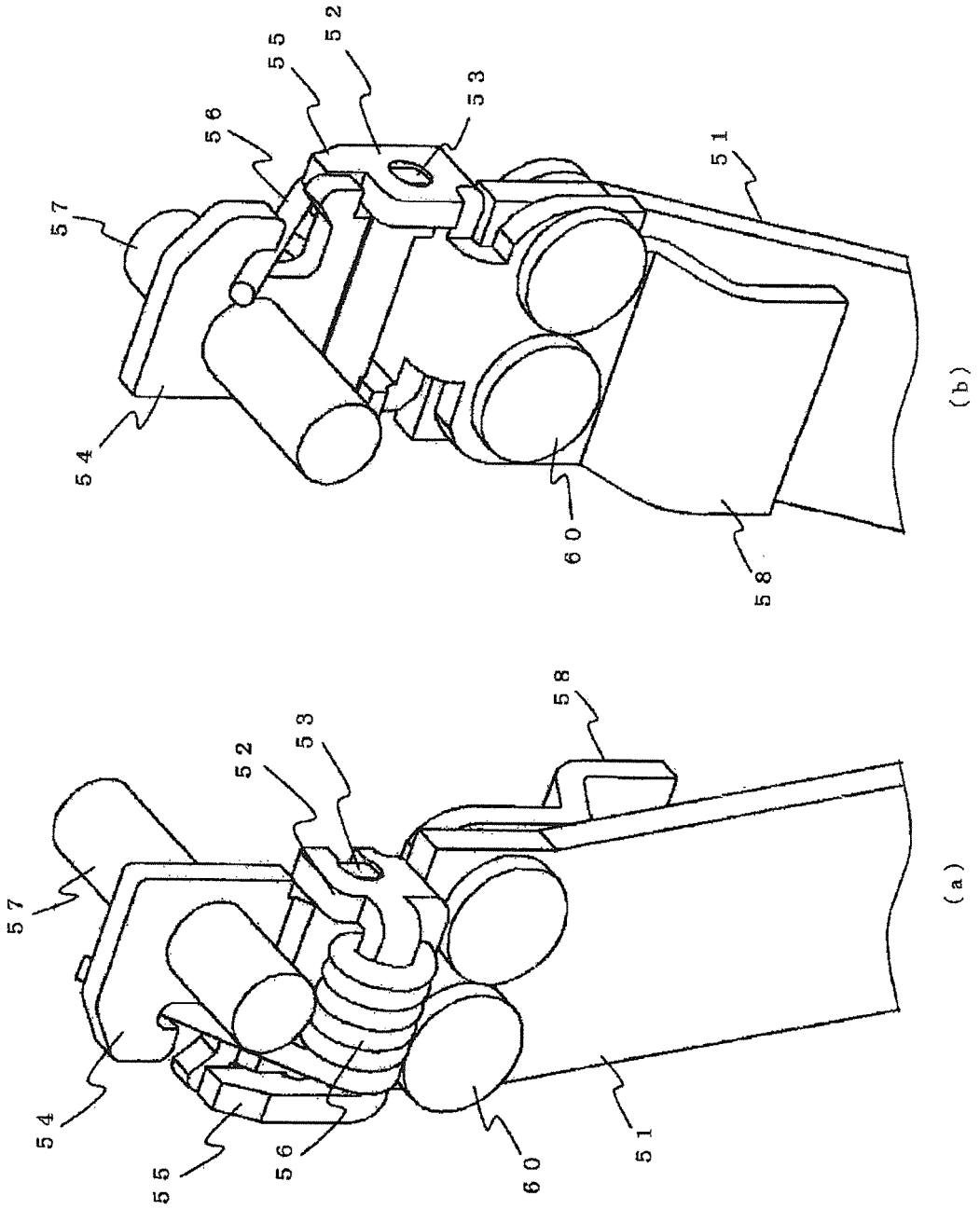


FIG. 3

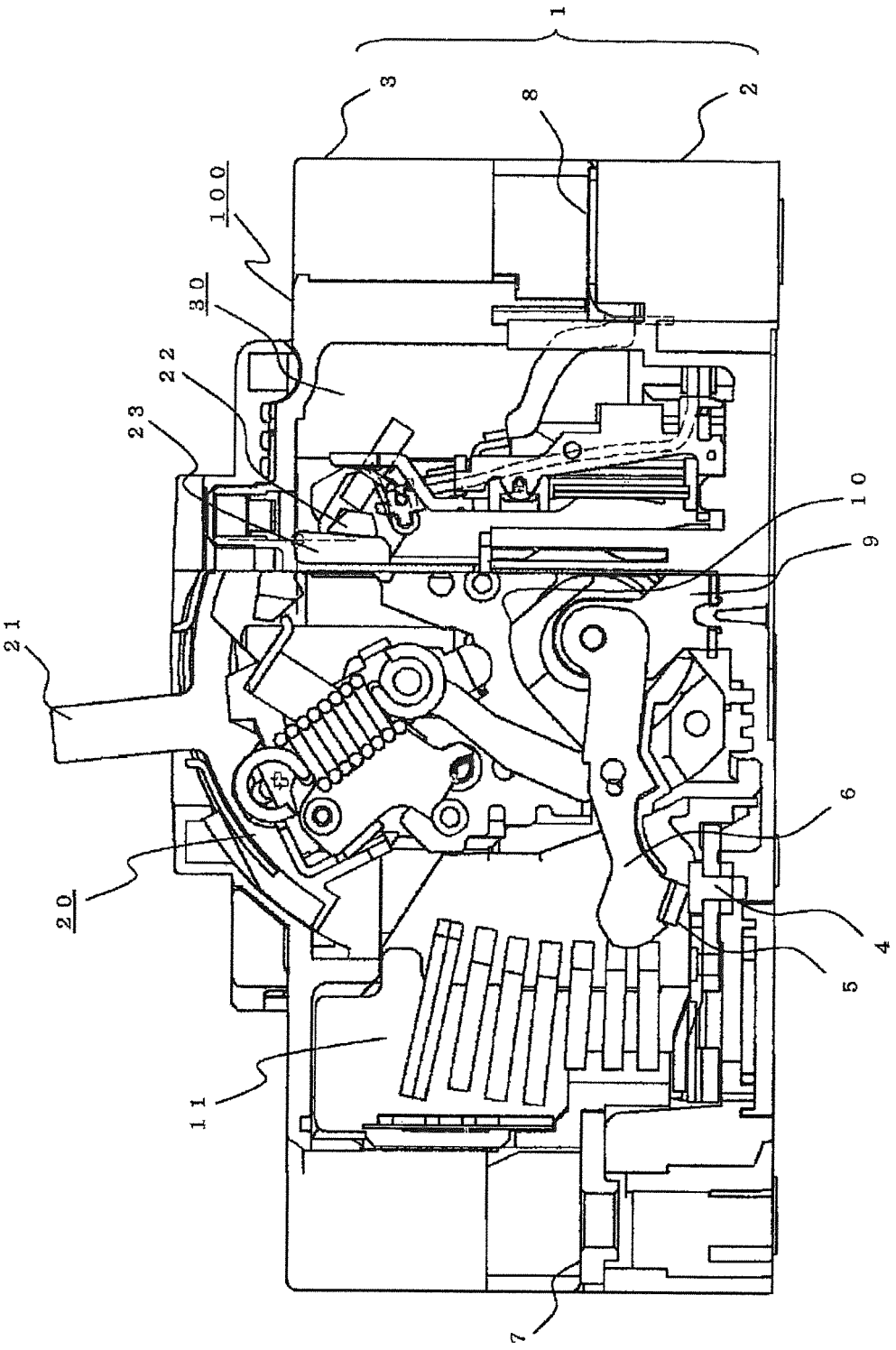


FIG. 4

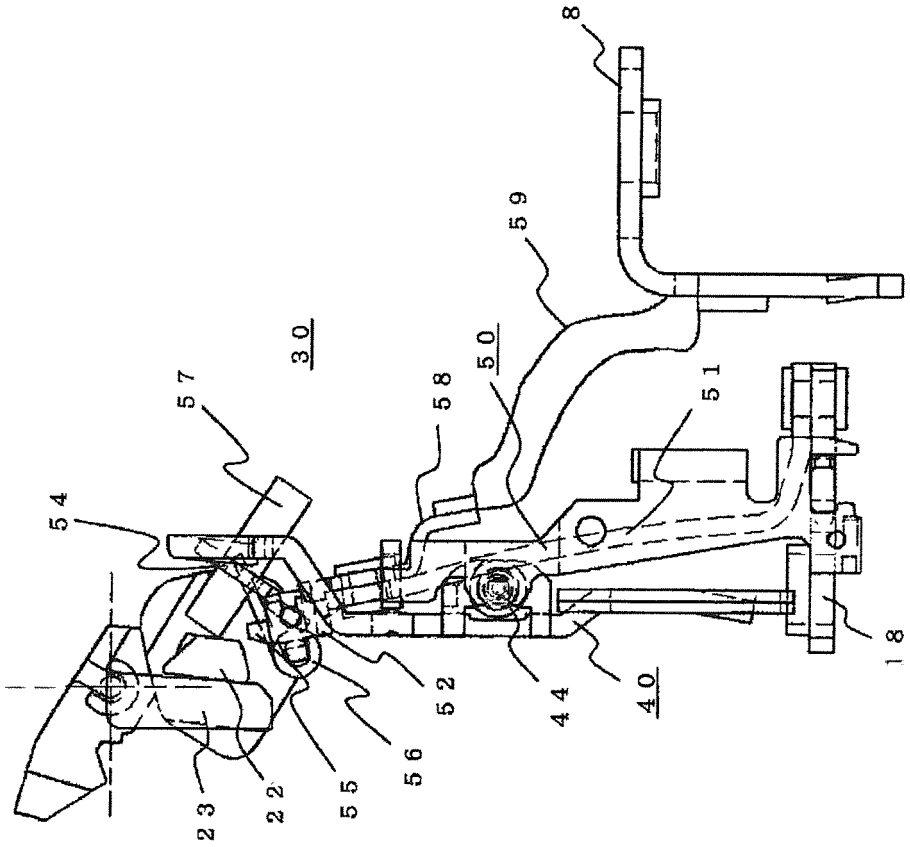


FIG. 5

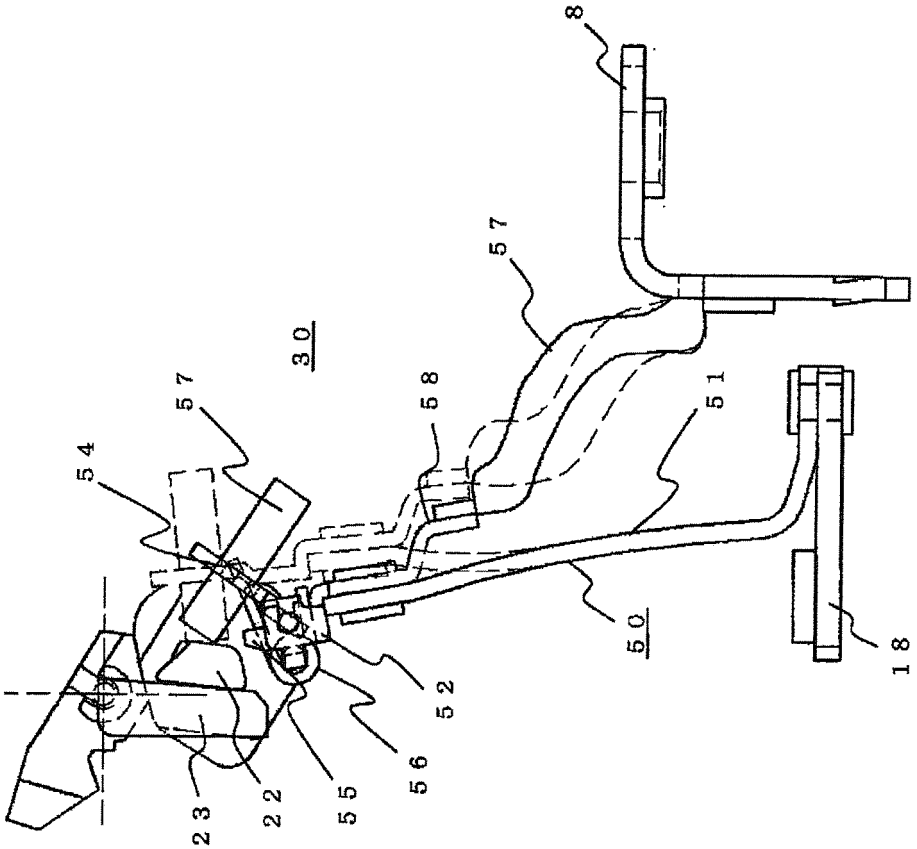
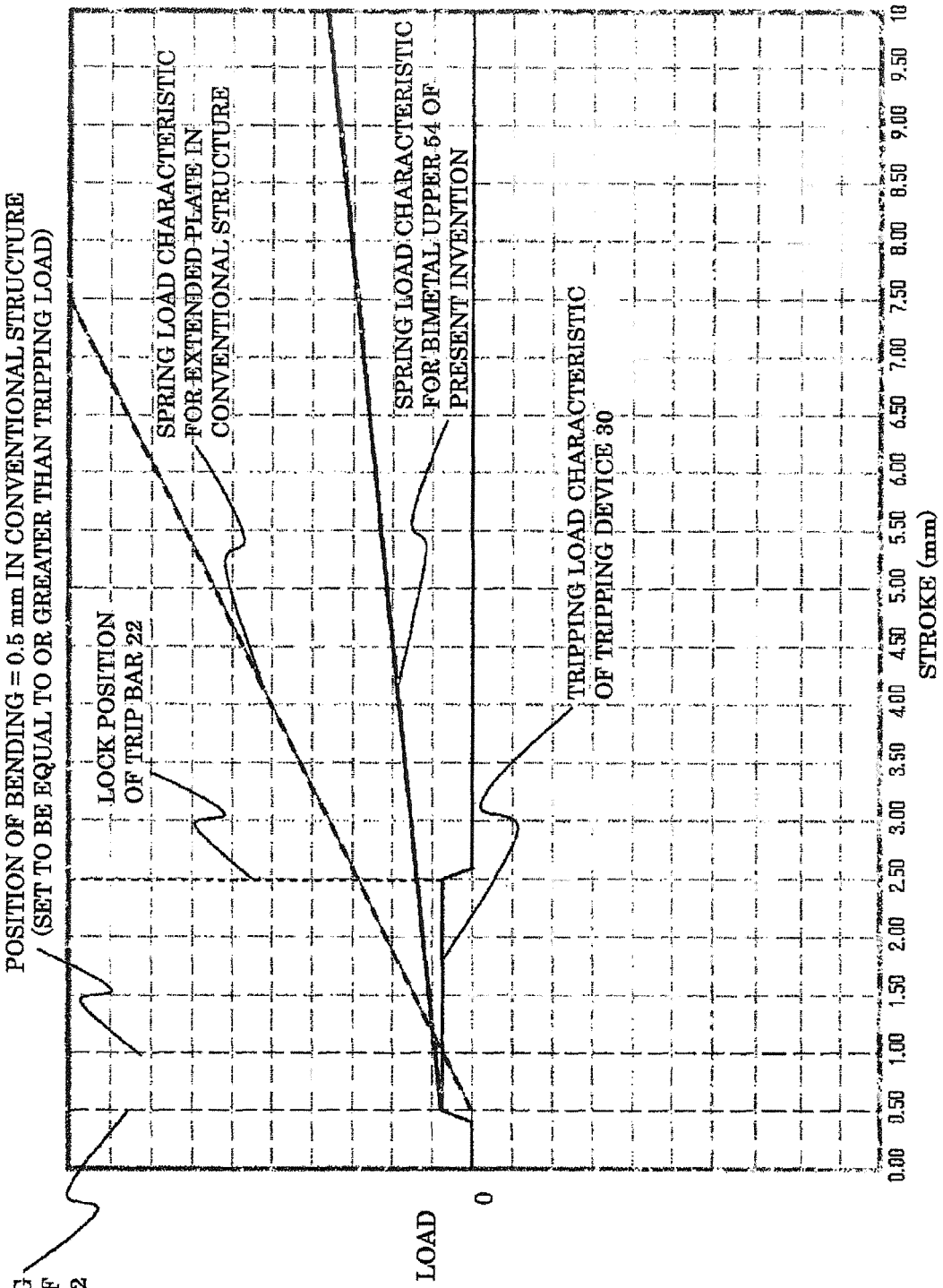


FIG. 6

FIG. 7


POSITION OF BENDING = 0.5 mm IN CONVENTIONAL STRUCTURE
(SET TO BE EQUAL TO OR GREATER THAN TRIPPING LOAD)
LOCK POSITION
OF TRIP BAR 22
SPRING LOAD CHARACTERISTIC
FOR EXTENDED PLATE IN
CONVENTIONAL STRUCTURE
SPRING LOAD CHARACTERISTIC
FOR BIMETAL UPPER 54 OF
PRESENT INVENTION
TRIPPING LOAD CHARACTERISTIC
OF TRIPPING DEVICE 30
ABUTTING
POSITION OF
TRIP BAR 22
LOAD
0
0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10
STROKE (mm)

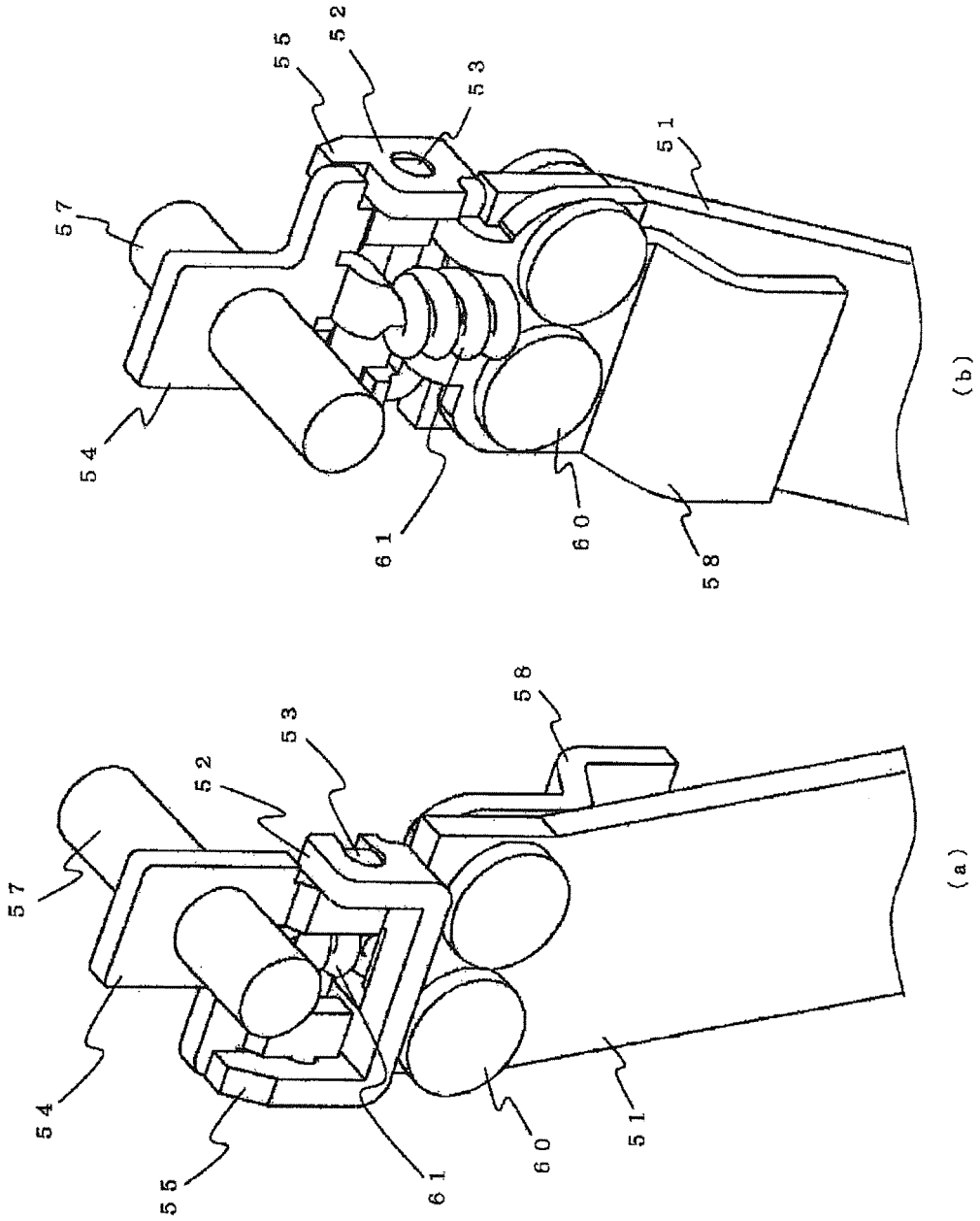


FIG. 8

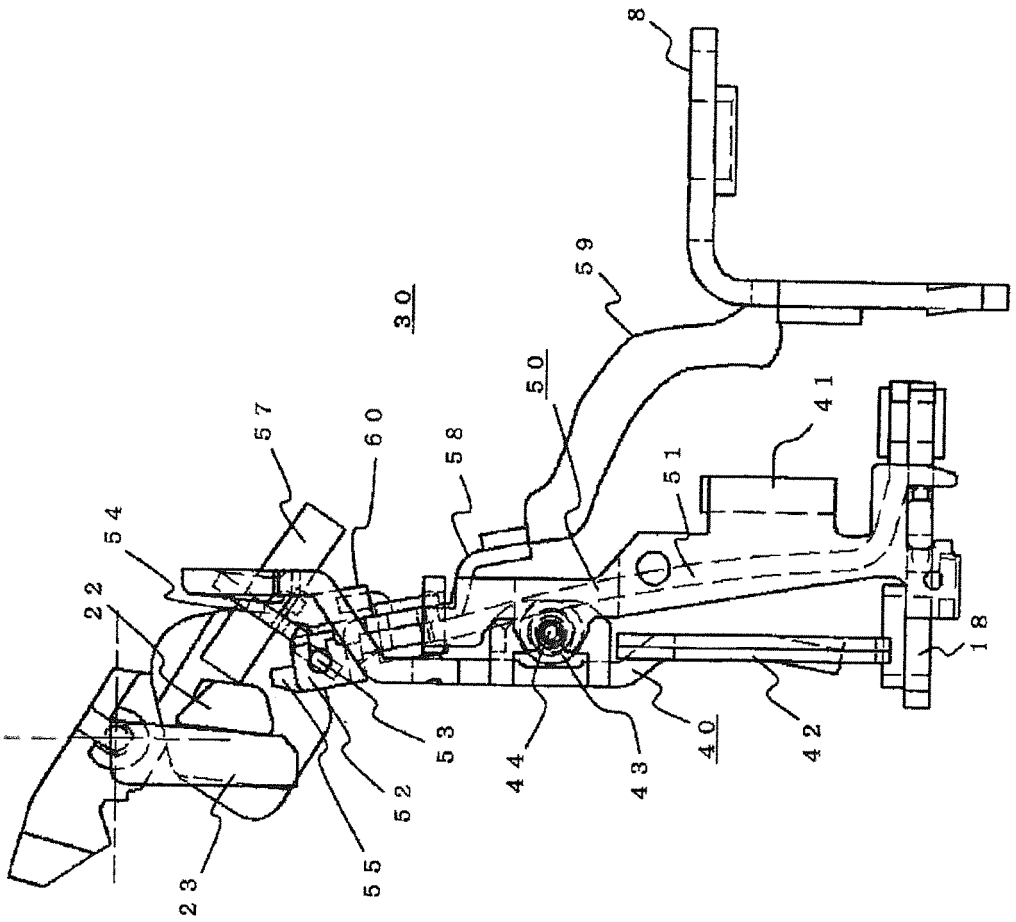


FIG. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2008153072 A **[0006]**
- JP 2010218765 A **[0006]**