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(71) Applicant: **MITSUBISHI DENKI KABUSHIKI KAISHA**
Chiyoda-ku, Tokyo 100-8310 (JP)

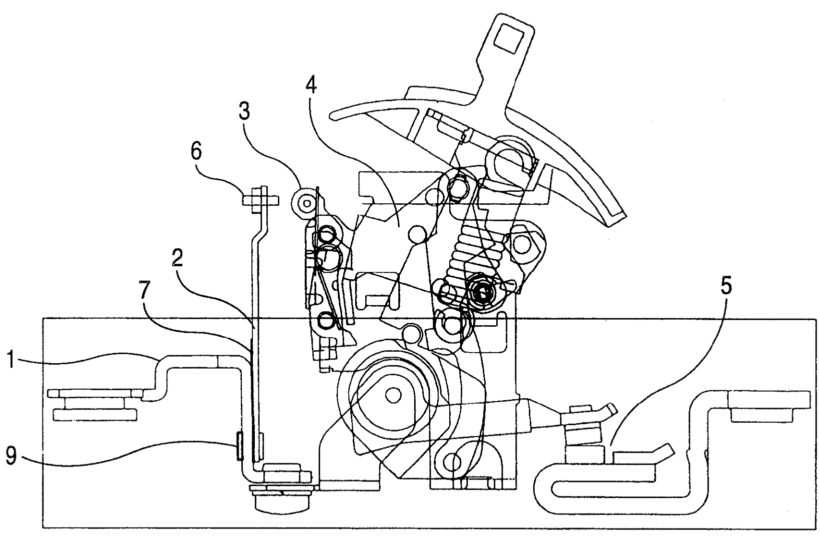
(72) Inventors:
- **MURAI, Masatoshi**
Chiyoda-ku,
Tokyo 100-8310 (JP)
- **KAWAMURA, Kouji**
Chiyoda-ku,
Tokyo 100-8310 (JP)
- **NAITO, Satoru**
Chiyoda-ku,
Tokyo 100-8310 (JP)

(74) Representative: **Sajda, Wolf E. et al**
Meissner, Bolte & Partner GbR
Postfach 86 06 24
81633 München (DE)

(54) CIRCUIT BREAKER AND THERMAL TRIP

(57) A thermal trip device where, to a heater (1) serving as a fixed terminal, the fixed end portion (22) of a bimetal (2), having one end portion that is an acting end portion (21) and another end portion that is a fixed end portion (22), is secured in a cantilevered manner to the heater (1), with the acting end portion (21) of the bimetal (2) bending when it is overheated as a result of electricity being supplied to the heater (1), wherein a temperature measuring member (7) is integrally directly coupled to a secured portion (221) of the bimetal (2) where the bimetal (2) is secured to the heater (1) in a state where the temperature measuring member (7) is exposed from the bimetal (2) and the heater (1) such that a contact temperature measuring instrument (8) can contact the temperature measuring member (7).

FIG. 1



EP 1 863 057 A1

Description

Technical Field

[0001] The present invention relates to a circuit breaker including a thermal trip device where the fixed end portion of a bimetal having one end portion that is an acting end portion and another end portion that is a fixed end portion is secured in a cantilevered manner to a fixed terminal, with the acting end portion causing tripping action of a circuit breaker body when the bimetal bends as a result of being overheated by an overcurrent flowing through the fixed terminal.
The present invention also relates to a thermal trip device where, to a heater serving as a fixed terminal, the fixed end portion of a bimetal having one end portion that is an acting end portion and another end portion that is a fixed end portion is secured in a cantilevered manner to the heater, with the acting end portion of the bimetal bending when it is overheated as a result of electricity being supplied to the heater.

Background Art

[0002] A thermal trip device is a device that detects an overcurrent in a circuit breaker, for example, and performs tripping of a main circuit of a circuit breaker body, the scope of its tripping characteristic when the overcurrent flows is determined by a standard such as JIS (Japanese Industrial Standard) that is the Japanese Industrial Standard, and it is necessary for products to satisfy that. However, in a thermal trip device, variations in its tripping characteristic cannot be avoided because of product variations in the configuring parts and variations in materials. Thus, ordinarily a structure for adjusting the tripping characteristic is incorporated to perform adjustment/inspection of the characteristic.

[0003] In order to adjust/inspect the tripping characteristic, it is necessary to accurately measure the characteristic value thereof. In a thermal trip device, its tripping characteristic is often measured by supplying a predetermined current and measuring the amount of time (trip time) from when supply of electricity starts to until the end of tripping and the displacement amount of a bimetal. Because the bending coefficient of the bimetal is already known, the displacement amount of the bimetal can be determined by measuring the temperature of the bimetal. Consequently, the tripping characteristic can be understood by measuring the temperature of the bimetal.

[0004] With respect to measuring the temperature of the bimetal, there is a line of thought which holds that methods of measuring the temperature of the bimetal without contacting the bimetal, so that the bending amount of the bimetal is not affected by the measurement, are preferable. The reason for this is, when the temperature of the bimetal is measured by a contact thermometer, deflection occurs in the bimetal because weight is applied from the outside to the bimetal via a probe, which causes the tripping characteristic to change.

[0005] In non-contact temperature measuring methods, it is common to use a radiation thermometer incorporating an infrared absorbing element. As can be seen in Patent Document 1, for example, non-contact temperature measurement in a thermal trip device of a conventional circuit breaker is done by disposing a window for measurement in the heater that heats the bimetal and measuring the temperature of the bimetal with a radiation thermometer through the window from a direction forming a right angle with respect to the surface of the bimetal such that the temperature of the bimetal can be measured by a non-contact thermometer.

[0006] Patent Document 1: U.S. Patent No. 5,317,471 specification and drawings.

Disclosure of the Invention

Problem that the Invention is to Solve

[0007] Although there is the line of thought which holds that non-contact temperature measuring methods using a non-contact thermometer are preferable, there is the problem that accurate temperature measurement is difficult in comparison to contact temperature measuring methods using a contact temperature because the surface of the bimetal is ordinarily a metallic luster surface. Further, in ground-fault interrupters incorporating ground-fault detection circuits and compacted circuit breakers, the gap around the bimetal is small, and so there are many blockers and it is often difficult to measure the bimetal surface temperature with a non-contact thermometer from the outside from a direction forming a right angle with respect to the surface of the bimetal.

[0008] Consequently, there is a desire to realize a thermal trip device, and a circuit breaker using this thermal trip device, whose tripping characteristic is not affected even when a contact thermometer is used.

[0009] The present invention has been made in light of the aforementioned circumstances, and it is an object thereof to provide a circuit breaker disposed with a thermal trip device whose tripping characteristic is not affected even when a contact thermometer is used and a thermal trip device.

Means for Solving the Problem

[0010] A circuit breaker pertaining to this invention is a circuit breaker including a thermal trip device where the fixed end portion of a bimetal having one end portion that is an acting end portion and another end portion that is a fixed end portion is secured in a cantilevered manner to a fixed terminal, with the acting end portion causing tripping action of a circuit breaker body when the bimetal bends as a result of being overheated by an overcurrent flowing through the fixed terminal, wherein a temperature measuring member is integrally directly coupled to a se-

cured portion of the bimetal where the bimetal is secured to the fixed terminal in a state where the temperature measuring member is exposed from the bimetal and the fixed terminal such that a contact temperature measuring instrument can contact the temperature measuring member.
Thus, the temperature of the bimetal can be measured without affecting the tripping characteristic because the temperature of the bimetal can be measured by bringing the contact temperature measuring instrument into contact with the temperature measuring member and not into direct contact with the bimetal.

[0011] Further, a thermal trip device pertaining to this invention is a thermal trip device where, to a heater serving as a fixed terminal, the fixed end portion of a bimetal having one end portion that is an acting end portion and another end portion that is a fixed end portion is secured in a cantilevered manner to the heater, with the acting end portion of the bimetal bending when it is overheated as a result of electricity being supplied to the heater, wherein a temperature measuring member is integrally directly coupled to a secured portion of the bimetal where the bimetal is secured to the heater in a state where the temperature measuring member is exposed from the bimetal and the heater such that a contact temperature measuring instrument can contact the temperature measuring member.
Hence, the temperature of the bimetal can be measured without affecting the tripping characteristic because the temperature of the bimetal can be measured by bringing the contact temperature measuring instrument into contact with the temperature measuring member and not into direct contact with the bimetal.

Effects of the Invention

[0012] The present invention is a circuit breaker including a thermal trip device where the fixed end portion of a bimetal having one end portion that is an acting end portion and another end portion that is a fixed end portion is secured in a cantilevered manner to a fixed terminal, with the acting end portion causing tripping action of a circuit breaker body when the bimetal bends as a result of being overheated by an overcurrent flowing through the fixed terminal, wherein a temperature measuring member is integrally directly coupled to a secured portion of the bimetal where the bimetal is secured to the fixed terminal in a state where the temperature measuring member is exposed from the bimetal and the fixed terminal such that a contact temperature measuring instrument can contact the temperature measuring member.
Thus, the temperature of the bimetal can be measured by bringing the contact temperature measuring instrument into contact with the temperature measuring member and not into direct contact with the bimetal, consequently the temperature of the bimetal can be measured without affecting the tripping characteristic, and moreover a contact temperature measuring method is employed, so highly precise temperature measurement is possible in comparison to when a non-contact temperature measuring method using a non-contact thermometer is employed.

[0013] The present invention is also a thermal trip device where, to a heater serving as a fixed terminal, the fixed end portion of a bimetal having one end portion that is an acting end portion and another end portion that is a fixed end portion is secured in a cantilevered manner to the heater, with the acting end portion of the bimetal bending when it is overheated as a result of electricity being supplied to the heater, wherein a temperature measuring member is integrally directly coupled to a secured portion of the bimetal where the bimetal is secured to the heater in a state where the temperature measuring member is exposed from the bimetal and the heater such that a contact temperature measuring instrument can contact the temperature measuring member.
Thus, the temperature of the bimetal can be measured by bringing the contact temperature measuring instrument into contact with the temperature measuring member and not into direct contact with the bimetal, consequently the temperature of the bimetal can be measured without affecting the tripping characteristic, and moreover a contact temperature measuring method is employed, so highly precise temperature measurement is possible in comparison to when a non-contact temperature measuring method using a non-contact thermometer is employed.

Best Modes for Implementing the Invention

Embodiment 1.

[0014] Embodiment 1 of this invention will be described below by FIG. 1 to FIG. 5. FIG. 1 is a side view showing a mechanical component inside a case of a circuit breaker including a thermal trip device, FIG. 2 is an enlarged perspective view showing the thermal trip device of FIG. 1, FIG. 3 is an enlarged side view showing the thermal trip device of FIG. 1, FIG. 4 is a perspective view for describing a way of measuring the temperature of a bimetal by a contact temperature measuring instrument, and FIG. 5 is an enlarged side view for describing bending action of the bimetal when electricity is supplied to a fixed terminal (i.e., a heater). In FIG. 1 to FIG. 5, the same reference numerals are given to the same portions.

[0015] In FIG. 1, operation when an overcurrent equal to or greater than a rated current flows to the circuit breaker is as follows.

(1) The temperature of a heater 1 or a bimetal 2 rises when an overcurrent flows to the heater 1 or the bimetal 2.
(2) The bimetal 2 bends in accompaniment with the rise in the temperature of the bimetal 2.
(3) The bending amount of the bimetal 2 becomes larger and the bimetal 2 pushes a trip bar 3.

(4) A mechanical component 4 is activated and instantaneously breaks (trips) a main circuit 5.

[0016] The scope of the time from when the overcurrent starts flowing to until tripping is determined by a standard such as JIS, and the trip time of products must satisfy that scope. However, the activation point of the tripping mechanism -- that is, the position where the bimetal 2 pushes the trip bar 3 -- varies because of the accumulation of manufacturing variations, such as production/assembly errors of each part configuring the tripping mechanism and variations in material characteristics, and variations arise in the amount of time (trip time) from when supply of electricity starts to until tripping. Thus, in order to absorb such manufacturing variations, an adjustment mechanism 6 is disposed in the distal end of the bimetal 2 or the trip bar 3 to perform adjustment/inspection work in the assembly process.

[0017] In the adjustment/inspection work, it is necessary to accurately measure the tripping characteristic per work. Ordinarily, the tripping characteristic is often measured by supplying a predetermined current value and measuring the trip time or measuring the displacement amount of the bimetal during that time.

However, the trip time and bimetal displacement amount are greatly affected by the temperature of the work when supply of electricity starts and by the temperature of the measurement environment, so the tripping characteristic is measured in a state where the temperature is managed at a constant temperature, or the measured value must be corrected on the basis of the temperature of the work and the surrounding temperature.

[0018] The bending amount (displacement amount) of a bimetal is determined by the temperature and bending coefficient of the bimetal, but because the bending coefficient is already known, the displacement amount can be determined by measuring the temperature of the bimetal. Consequently, it is possible to measure the tripping characteristic by measuring the temperature of the bimetal.

[0019] As mentioned previously, a non-contact radiation thermometer is commonly used to measure the temperature of the bimetal. The reason is because deflection in the bimetal occurs due to the contact weight of a probe when a contact thermometer is used, the tripping characteristic changes, and accurate measurement of the tripping characteristic cannot be done.

[0020] A non-contact thermometer measures the temperature of an object by detecting the radiation energy amount of infrared rays radiated from the object. The radiation amount of infrared rays radiated from an object differs depending on the material and surface state, and even at the same temperature the radiated infrared ray energy amount (emissivity) differs. With a non-contact thermometer, the temperature is calculated on the basis of an ideal black body (theoretical object whose emissivity is 100%), and with objects other than that, correction must be performed in accordance with each individual emissivity.

[0021] Emissivity is ordinarily experimentally obtained and cannot be determined per work during the mass production process because determining the emissivity of a measured object in a short amount of time is difficult. Consequently, when the emissivity of a bimetal varies, those variations become variations in temperature measurement.

Moreover, because the surface of a bimetal is commonly a metallic luster surface, it is easy for infrared rays radiated from a heat source of an object in the vicinity of the bimetal, such as a heater, to be reflected by the surface of the bimetal. When that reflected light is made incident on a radiation thermometer, it becomes measurement error.

[0022] Thus, in Embodiment 1 of this invention, temperature measurement is enabled at a place other than at the portion where the bimetal 2 bends in order to push the trip bar 3, that is, other than at an acting end portion 21. Thus, temperature measurement by a contact thermometer becomes possible without affecting the bending amount of the acting end portion 21 of the bimetal 2, so temperature measurement can be stably done with high precision in comparison to a conventional non-contact thermometer.

[0023] In heating the bimetal 2, a temperature distribution is present inside the bimetal 2 because it is difficult to uniformly heat the entire bimetal 2. That is, when the fixed end portion 22 of a bimetal having one end portion that is an acting end portion 21 and another end portion that is a fixed end portion 22 is secured in a cantilevered manner to a fixed terminal (i.e., a heater) 1, the temperature of the acting end portion 21 is slightly lower than the temperature of the fixed end portion 22 that is secured to the fixed terminal (i.e., the heater) 1.

However, the relationship between the temperature distribution inside the bimetal 2 and the bending amount of the acting end portion 21 of the bimetal 2 is determined beforehand by the material and size of the bimetal 2, so even when the temperature of the fixed end portion 22 is measured, the desired bending amount of the acting end portion 21 of the bimetal 2 at that temperature can be determined.

Further, conversely, the standard temperature of the fixed end portion 22 when the acting end portion 21 of the bimetal 2 has reached the desired bending amount (i.e., when it has reached a bending amount that trips the circuit breaker) can also be determined. In other words, if the measured temperature of the fixed end portion 22 when the acting end portion 21 of the bimetal 2 has reached the desired bending amount (i.e., when it has reached a bending amount that trips the circuit breaker or when the circuit breaker trips) is the same as the standard temperature, then it can be said that the tripping characteristic of a thermal trip device is a predetermined tripping characteristic.

[0024] Thus, in Embodiment 1 of this invention, a part that reaches a temperature that is equivalent to the temperature of the fixed end portion 22 of the bimetal 22, that is, a temperature measuring member 7, is added, whereby temperature measurement of the fixed end portion 22 of the bimetal 2 becomes possible by measuring the temperature of this added temperature measuring member 7 with a contact thermometer instead of directly measuring the temperature of the fixed end portion 22 of the bimetal 2.

That is, as shown in FIG. 4, the temperature of the bimetal 2 can be indirectly measured by measuring the temperature of the temperature measuring member 7 by bringing a probe 81 of a contact thermometer 8 into contact with the temperature measuring member 7.

[0025] As shown in FIG. 2 to FIG. 4, the temperature measuring member 7 is integrally directly coupled to a secured portion 221 of the bimetal 2 where the bimetal 2 is secured to the fixed terminal (i.e., the heater) 1 in a state where the temperature measuring member 7 is exposed from the bimetal 2 and the fixed terminal (i.e., the heater) 1 such that the probe 81 of the contact temperature measuring instrument 8 can contact the temperature measuring member 7. That is, as is shown, the area of the entire temperature measuring member 7 is larger than the area of the portion of the temperature measuring member 7 that faces the fixed terminal (i.e., the heater) 1.

[0026] Further, the temperature measuring member 7 is present between the bimetal 2 and the fixed terminal (i.e., the heater) 1 and is firmly secured to the bimetal 2 and the fixed terminal (i.e., the heater) 1 by caulking pins 9 at plural places. That is, the fixed end portion 22 of the bimetal 2, the temperature measuring member 7, and the fixed terminal (i.e., the heater) 1 are tightly integrally coupled together by the caulking pins 9 so that a coupled state that is also thermally good is maintained.

[0027] Inspection of the tripping characteristic is performed on just the thermal trip device shown in FIG. 2 to FIG. 5 or is performed in a state where the thermal trip device is incorporated in the circuit breaker as in FIG. 1, but in that case, when a current corresponding to a predetermined overcurrent is supplied to the fixed terminal (i.e., the heater) 1, then as shown in FIG. 5, the acting end portion 21 of the bimetal 2 bends as indicated by the one-dotted chain line and the temperature measuring member 7 also bends as indicated by the one-dotted chain line in the same direction as the acting end portion 21 of the bimetal 2.

[0028] Because the temperature measuring member 7 is formed by the same material as the bimetal 2 (i.e., when the bimetal 2 is a material where steel and copper are laminated together, the temperature measuring member 7 is also a laminate material of steel and copper) and the length of the temperature measuring member 7 is shorter than the length of the bimetal 2, the bending amount of the temperature measuring member 7 is smaller than the bending amount of the acting end portion 21 of the bimetal 2 even when the acting end portion 21 of the bimetal 2 and the temperature measuring member 7 bend as indicated by the one-dotted chain lines, so a slight gap g occurs between the distal end portion of the temperature measuring member 7 and the acting end portion 21 of the bimetal 2.

Consequently, the temperature measuring member 7 does not contact and press against the acting end portion 21 of the bimetal 2 because of that bending and does not adversely affect the bending amount of the acting end portion 21 of the bimetal 2.

[0029] When the temperature measuring member 7 is configured to bend oppositely from the one-dotted chain line in FIG. 5, it presses against the acting end portion 21 of the bimetal 2 at the time of that bending and adversely affects the bending amount of the acting end portion 21 of the bimetal 2, so attaching the temperature measuring member 7 such that it bends oppositely from the one-dotted chain line in FIG. 5 must be avoided.

<u>Embodiment 2.</u>

[0030] Embodiment 2 of this invention will be described below by FIG. 6 to FIG. 8. FIG. 6 is a perspective diagram showing a thermal trip device, FIG. 7 is a side view showing the thermal trip device, and FIG. 8 is an enlarged side view for describing bending action of the bimetal when electricity is supplied to the fixed terminal (i.e., the heater).

[0031] As shown in FIG. 6 to FIG. 8, Embodiment 2 of this invention is a case example when the temperature measuring member 7 extends from the secured portion 221 of the bimetal 2 on the opposite side of the acting end portion 21 of the bimetal.

[0032] In this case, the temperature measuring member 7 extends on the opposite side of the acting end portion 21 and forms the bimetal 2 itself. In other words, the temperature measuring member 7 is integrally directly coupled to the secured portion 221 of the bimetal 2 where the bimetal 2 is secured to the fixed terminal (i.e., the heater) 1 in a state where the temperature measuring member 7 is exposed from the bimetal 2 and the fixed terminal (i.e., the heater) 1 such that the contact temperature measuring instrument 8 can contact the temperature measuring member 7, and the temperature measuring member 7 extends from the secured portion 221 of the bimetal 2 on the opposite side of the acting end portion 21 of the bimetal 2.

[0033] In the case of Embodiment 2 of this invention, as shown in FIG. 7 and FIG. 8, the temperature of the bimetal 2 is indirectly measured by allowing the distal end of the probe 81 of the contact temperature measuring instrument 8 to abut against the undersurface of the temperature measuring member 7 and measuring the temperature of the temperature measuring member 7.

[0034] In the case of Embodiment 2 of this invention, a current corresponding to a predetermined overcurrent is supplied to the fixed terminal (i.e., the heater) 1, so that even when the temperature measuring member 7 bends as indicated by the one-dotted chain line, a slight gap G arises between the distal end portion of the tem-

perature measuring member 7 and the fixed terminal (i.e., the heater) 1.
Consequently, force does not act on the fixed end portion 22 of the bimetal 2 as a result of the temperature measuring member 7 abutting against the fixed terminal (i.e., the heater) 1 because of that bending and does not adversely affect the bending amount of the acting end portion 21 of the bimetal 2.

Embodiment 3.

[0035] In Embodiment 3 of this invention, as shown in FIG. 9, a probe insertion through hole 12a whose diameter is larger than the diameter of the probe 81 of the contact temperature measuring instrument 8 is disposed in the fixed terminal (i.e., the heater) 1, the probe 81 is inserted into this probe insertion through hole 12a such that the probe 81 does not contact the fixed terminal (i.e., the heater) 1, and the distal end of the probe 81 is allowed to abut against the undersurface of the temperature measuring member 7 to measure the temperature of the temperature measuring member 7, whereby the temperature of the bimetal 2 is indirectly measured. Even when configured in this manner, effects that are the same as those of the aforementioned Embodiment 2 of this invention are provided.

[0036] In Embodiment 3 of this invention, specifically, as is shown, the probe insertion through hole 12a is disposed in an inside terminal portion 12 in the end portion on the opposite side of an outside terminal portion 11 including a connection hole 11 a of the circuit breaker.

Embodiment 4.

[0037] As shown in FIG. 10, Embodiment 4 of this invention has a structure where the inside terminal portion 12 extends long inside the circuit breaker body and a connection hole 12b that connects to a connection terminal (not shown) inside the circuit breaker body is disposed in a position a predetermined distance away from the probe insertion hole 12a further inside the circuit breaker body, so that connection to the connection terminal (not shown) inside the circuit breaker body can be easily performed.

Brief Description of the Drawings

[0038]

FIG. 1	A diagram showing Embodiment 1 of this invention, being a side view showing a mechanical component inside a case of a circuit breaker including a thermal trip device.
FIG. 2	A diagram showing Embodiment 1 of this invention, being an enlarged perspective view showing the thermal trip device of FIG. 1.
FIG. 3	A diagram showing Embodiment 1 of this invention, being an enlarged side view showing the thermal trip device of FIG. 1.
FIG. 4	A diagram showing Embodiment 1 of this invention, being a perspective view for describing a way of measuring the temperature of a bimetal with a contact temperature measuring instrument.
FIG.5	A diagram showing Embodiment 1 of this invention, being an enlarged side view for describing bending action of the bimetal when electricity is supplied to a fixed terminal (i.e., a heater).
FIG. 6	A diagram showing Embodiment 2 of this invention, being a perspective view showing a thermal trip device.
FIG. 7	A diagram showing Embodiment 2 of this invention, being a side view showing the thermal trip device.
FIG. 8	A diagram showing Embodiment 2 of this invention, being an enlarged side view for describing bending action of the bimetal when electricity is supplied to the fixed terminal (i.e., the heater).
FIG. 9	A diagram showing Embodiment 3 of this invention, being a side view showing a thermal trip device.
FIG. 10	A diagram showing Embodiment 4 of this invention, being a side view showing a thermal trip device.

Description of the Reference Signs

[0039]

1	= Fixed Terminal (Heater)
11	= Outside Terminal Portion
11 a	= Connection Hole
12	= Inside Terminal Portion
12a	= Probe Insertion Through Hole
12b	= Connection Hole
2	= Bimetal
21	= Acting End Portion
22	= Fixed End Portion
221	= Secured Portion
3	= Trip Bar
4	= Mechanical Component
5	= Main Circuit
6	= Adjustment Mechanism
7	= Temperature Measuring Member
8	= Contact Thermometer
81	= Probe
9	= Caulking Pin
g	= Gap
G	= Gap

Claims

1. A circuit breaker including a thermal trip device where the fixed end portion of a bimetal having one end portion that is an acting end portion and another end portion that is a fixed end portion is secured in a cantilevered manner to a fixed terminal, with the acting end portion causing tripping action of a circuit breaker body when the bimetal bends as a result of being overheated by an overcurrent flowing through the fixed terminal, wherein a temperature measuring member is integrally directly coupled to a secured portion of the bimetal where the bimetal is secured to the fixed terminal in a state where the temperature measuring member is exposed from the bimetal and the fixed terminal such that a contact temperature measuring instrument can contact the temperature measuring member.

2. The circuit breaker of claim 1, wherein the temperature measuring member is present between the bimetal and the fixed terminal and is secured to the bimetal and the fixed terminal.

3. The circuit breaker of claim 1, wherein the temperature measuring member extends from the secured portion of the bimetal on the opposite side of the acting end portion of the bimetal.

4. The circuit breaker of any of claims 1 to 3, wherein the temperature measuring member is formed by the same bimetal as the bimetal and bends in a direction away from the fixed terminal when overheated by the overcurrent flowing through the fixed terminal.

5. A thermal trip device where, to a heater serving as a fixed terminal, the fixed end portion of a bimetal having one end portion that is an acting end portion and another end portion that is a fixed end portion is secured in a cantilevered manner to the heater, with the acting end portion of the bimetal bending when it is overheated as a result of electricity being supplied to the heater,
wherein a temperature measuring member is integrally directly coupled to a secured portion of the bimetal where the bimetal is secured to the heater in a state where the temperature measuring member is exposed from the bimetal and the heater such that a contact temperature measuring instrument can contact the temperature measuring member.

6. The thermal trip device of claim 5, wherein the temperature measuring member is present between the bimetal and the heater and is secured to the bimetal and the heater.

7. The thermal trip device of claim 6, wherein the area of the temperature measuring member is larger than the area of the portion of the temperature measuring member that faces the heater.

8. The thermal trip device of claim 5, wherein the temperature measuring member extends from the secured portion of the bimetal on the opposite side of the acting end portion of the bimetal.

9. The thermal trip device of claim 8, wherein a probe insertion through hole whose diameter is larger than the diameter of a probe of the contact temperature measuring instrument is disposed in the heater.

10. The thermal trip device of any of claims 5 to 9, wherein the temperature measuring member is formed by the same bimetal as the bimetal and bends in a direction away from the heater when overheated as a result of electricity being supplied to the heater.

FIG. 1

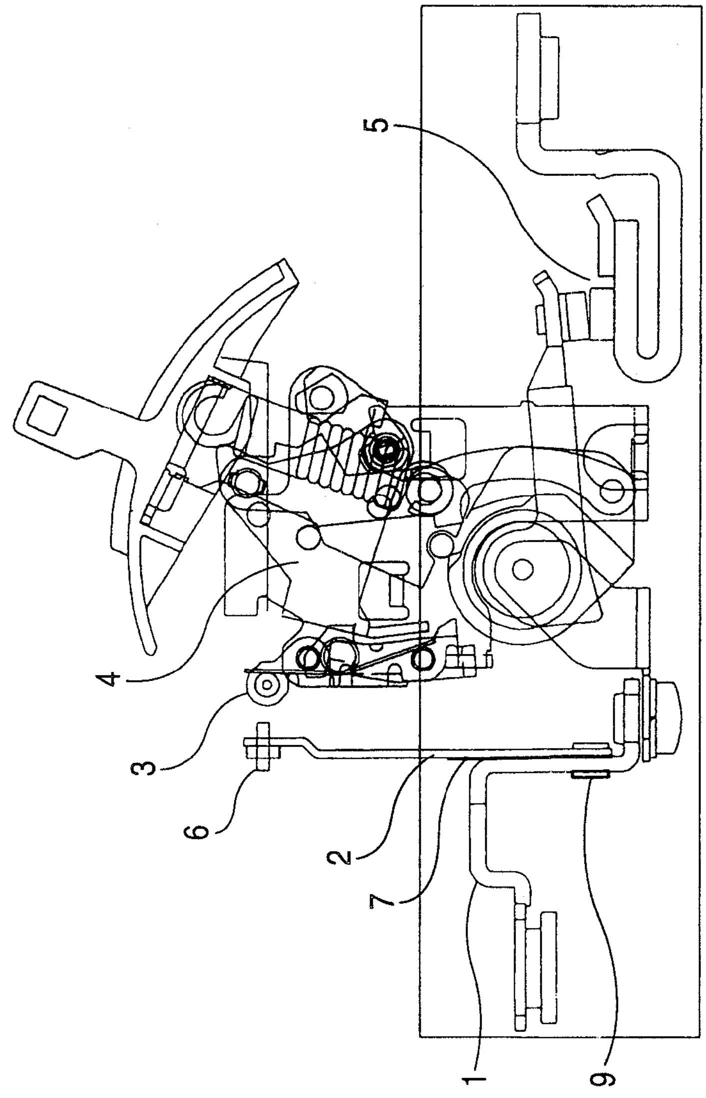


FIG. 2

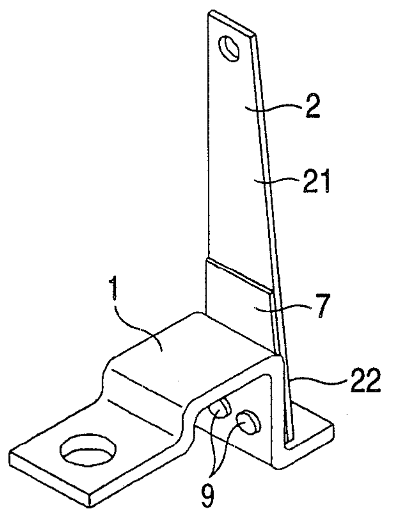


FIG. 3

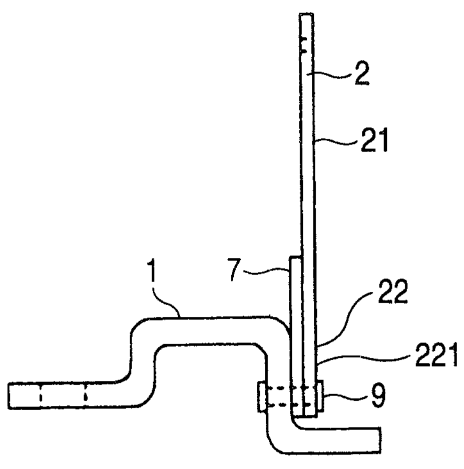


FIG. 4

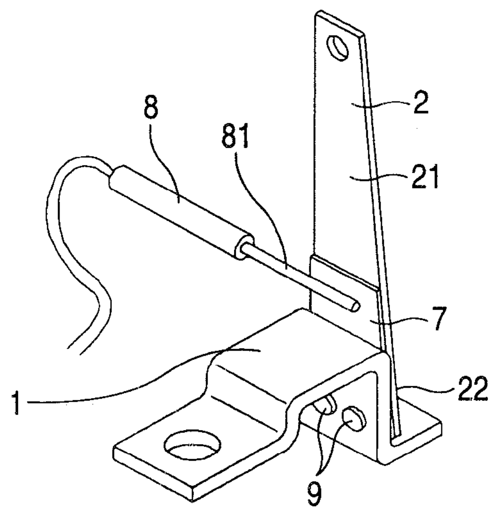


FIG. 5

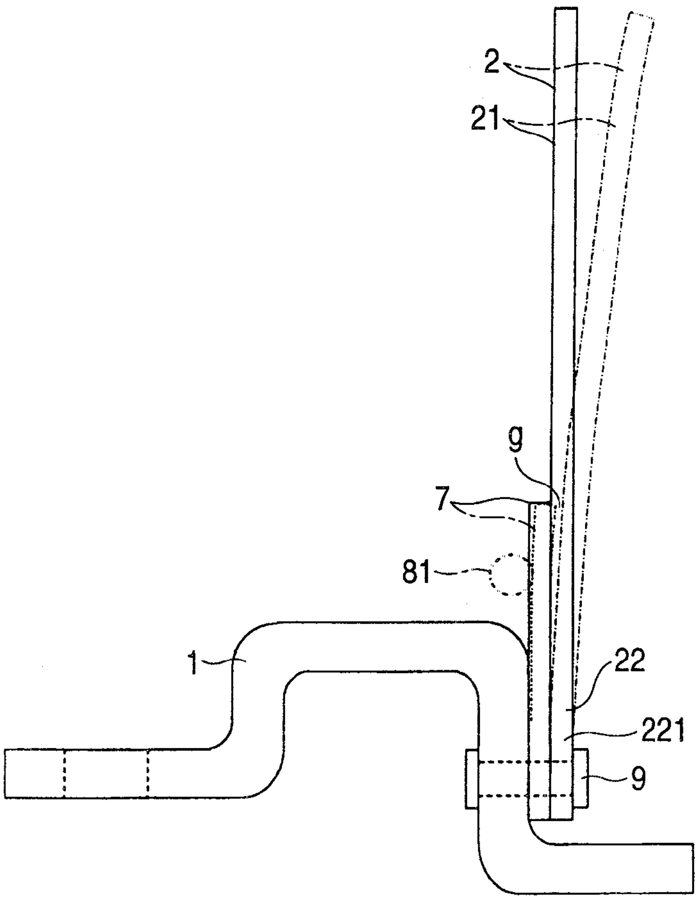


FIG. 6

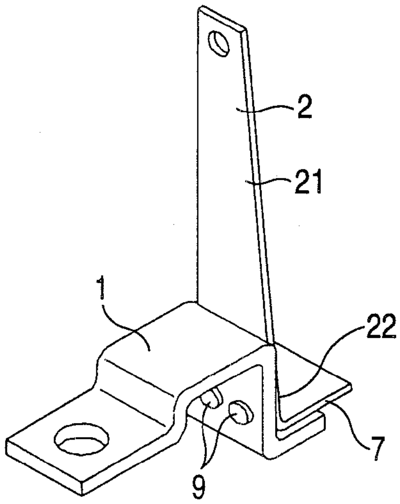


FIG. 7

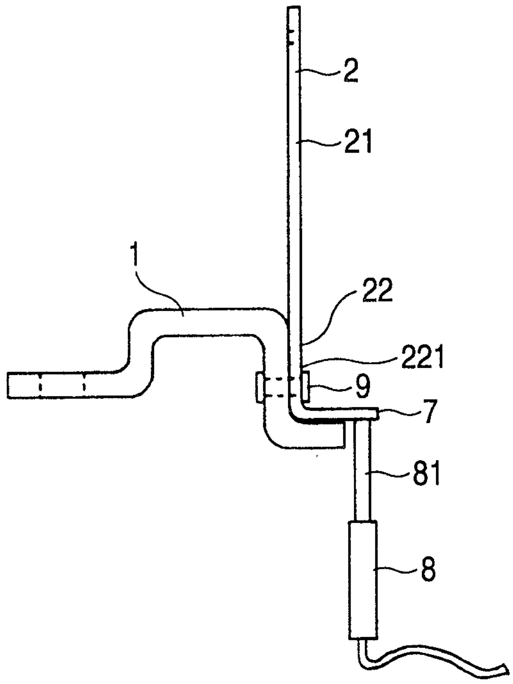


FIG. 8

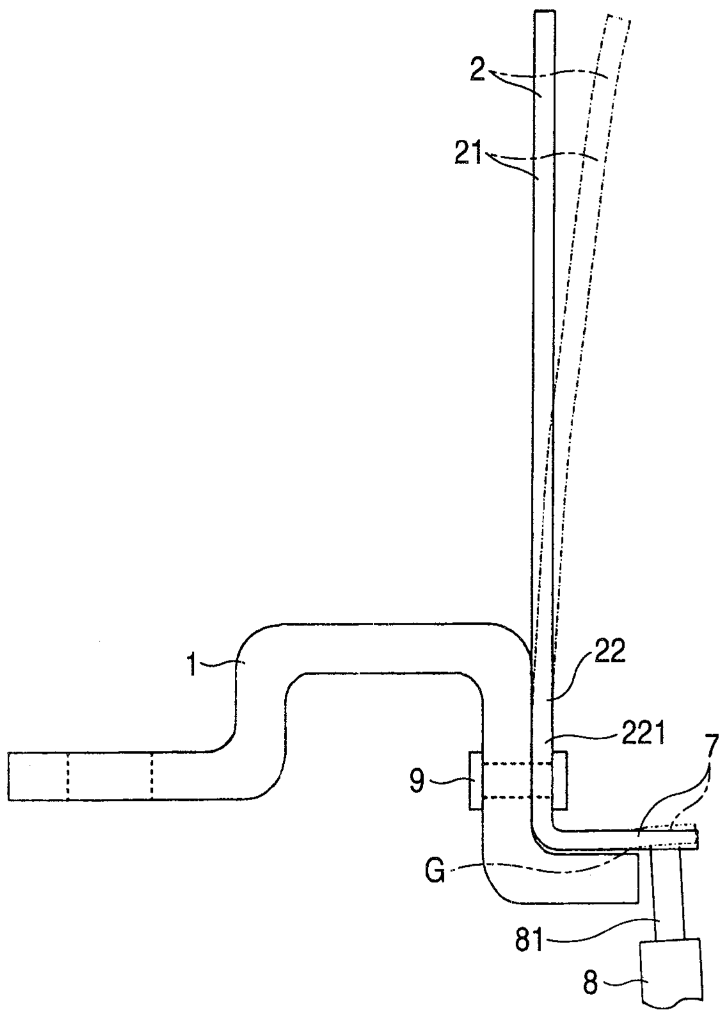


FIG. 9

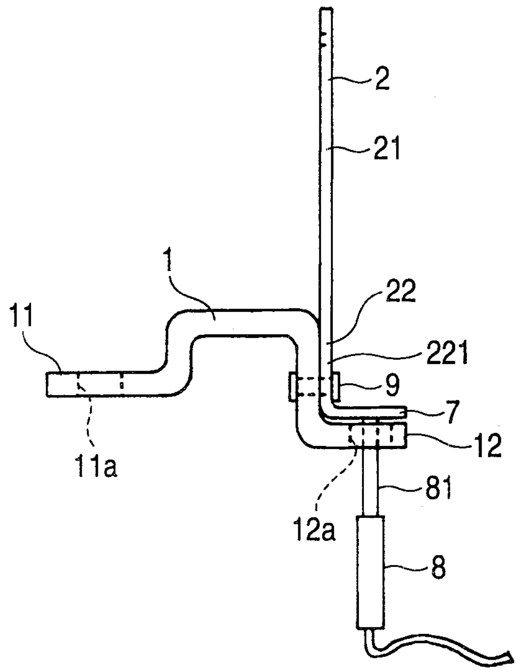
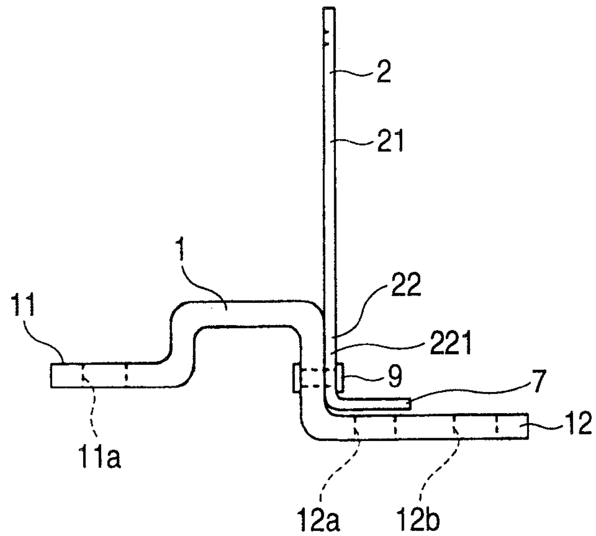


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2005/005562

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl^7 H01H73/22, 61/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl^7 H01H73/22, 61/00

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2005
Kokai Jitsuyo Shinan Koho	1971-2005	Toroku Jitsuyo Shinan Koho	1994-2005

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5317471 A (Jean Izoard, Bresson), 31 May, 1994 (31.05.94), Full text; Figs. 1 to 4 & EP 542641	1-10
A	JP 2002-324473 A (Matsushita Electric Works, Ltd.), 08 November, 2002 (08.11.02), Full text; Figs. 1 to 26 (Family: none)	1-10

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"P" document published prior to the international filing date but later than the priority date claimed
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 June, 2005 (17.06.05)	05 July, 2005 (05.07.05)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2004)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5317471 A **[0006]**