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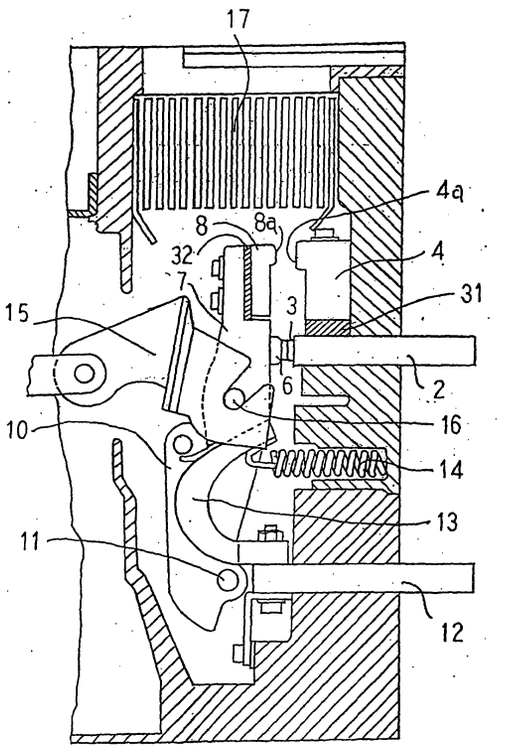
(54) AIR CIRCUIT BREAKER

(57) Any alloy contact is not required for arcing contacts disposed on an arc suppressor.

A first resistor 31 is interposed between a stationary conductor 2 and a stationary arcing contact 4a, and a second resistor 32 is interposed between a moving member 7 and a moving arcing contact 8a. When the moving member is on, the moving arcing contact 8a comes in contact with the stationary arcing contact 4a, and after bringing a moving contact 6 into contact with a stationary contact 3, the moving arcing contact 8a moves away from the stationary arcing contact 4a. When the moving member is off, the moving arcing contact 8a comes in contact with the stationary arcing contact 4a, and after the moving contact 6 moves away from the stationary contact 3, the moving arcing contact 8a is connected and disconnected with the stationary arcing contact 4a, thus first resistor 31 and second resistor 32 limit a current flowing through the two contacts at opening and closing.

Fig. 1



EP 1 492 138 A1

Description

Technical Field

[0001] The present invention relates to an improvement in opening and closing contacts of an air circuit breaker.

Background Art

[0002] Fig. 4 is a side sectional view of a conventional air circuit breaker described in, for example, Japanese Patent Publication (unexamined) No. 90424/1990.

[0003] In the drawing, reference numeral 1 is a housing formed of an insulating material, and numeral 2 is stationary conductors which are arranged in parallel on the housing 1 and are the same in number as poles, and in which a stationary contact 3 is fixed onto one end of each stationary conductor, and the other end is led out from the rear side of the housing 1 and forms a power supply side terminal 2a. Numeral 4 is a stationary arcing conductor extending from the stationary conductor 2 toward an arc suppressor described later, and numeral 5 is a stationary arcing contact fixed onto an end portion of the stationary arcing conductor 4.

[0004] Numeral 6 is a moving contact that faces the stationary contact 3 and comes in contact with and moves away from the stationary contact 3, numeral 7 is a moving member to which the moving contact 6 is fixed, numeral 8 is a moving arcing conductor formed by extending the moving member 7 toward the arc suppressor, and numeral 9 is a moving arcing contact fixed onto an end portion of the moving arcing conductor 8.

[0005] Numeral 10 is a contact arm rotatably holding the moving member 7, and numeral 11 is a contact arm shaft rotatably supporting the contact arm 10 on the housing 1. Numeral 12 is a terminal conductor, and the terminal conductor is fixed onto the housing 1 and led out from the rear side of the housing 1, and forms a power supply side terminal 12a. Numeral 13 is a flexible conductor movably connecting the moving member 7 to the terminal conductor 12. Numeral 14 is a contact pressure spring urging the moving member 7 toward an opening direction, and numeral 15 is a switch mechanism, numeral 16 is a shaft acting as the turning center of the moving member 7. Numeral 17 is an arc suppressor, and numeral 18 is a trip relay part.

[0006] The switch mechanism 15 is comprised of a well- known toggle link mechanism, and opens and closes the moving member 7 in order to switch on and off the air circuit breaker. Under the state that the air circuit breaker is switched on, the switch mechanism 15 is hitched on a latch (not shown) engaged with the trip relay part 18 to keep the air circuit breaker on. If the hitched switch mechanism 15 is released from the latch, the air circuit breaker is switched off. Numeral 19 is a closing spring where closing drive force of the switch mechanism 15 is accumulated, and numeral 20 is a cam mechanism where a handle 21 or a motor not shown compresses the closing spring 19 and accumulates the force thereof.

[0007] This type of air circuit breaker detects an overcurrent flowing through a connected load or an excessively large current due to an accident or the like, and the trip relay part 18 releases the hitched switch mechanism 15 from the latch, whereby the switch mechanism 15 comes to work. This pushes upward the contact arm 10 round the contact arm shaft 11 by a force of the contact pressure spring 14, and the moving member 7 is rotated counterclockwise round the shaft 16. Accordingly, the moving contact 6 is moved away from the stationary contact 3, and the electric current flowing between the two contacts is interrupted.

[0008] The contact arm 10, the shaft 16, and the contact arm shaft 11 are located so that the moving member 7 connected to the switch mechanism 15 oscillates in on-off operation. Oscillating operation of the moving member 7 is hereinafter described.

[0009] When the air circuit breaker is on, the moving contact 6 is in contact with the stationary contact 3, but the moving arcing contact 9 is spaced away from the stationary arcing contact 5. When turning off, the switch mechanism 15 raises the contact arm 10, whereby the moving contact 6 is slightly moved away from the stationary contact 3, and an arc through between the two contacts conducts. Subsequently, the moving member 7 is rotated clockwise round the shaft 16 pushed by the contact pressure spring 14 and, and the moving arcing contact 9 comes in contact with the stationary arcing contact 5. By the raising operation of the switch mechanism 15, while the moving arcing contact 9 being kept in contact with the stationary arcing contact 5, the moving contact 6 is largely moved away from the stationary contact 3 using this contacting point as a fulcrum, thereby the arc between the contacts is extended and the current flow shifts mainly to the moving arcing contact 9 and the stationary arcing contact 5. By the operation of the switch mechanism 15, the moving member 7 is rotated counterclockwise, the moving arcing contact 9 moves away from the stationary arcing contact 5, and the arc generated there is induced and extinguished by the arc suppressor 17.

[0010] When turning on, the moving member 7 rotates clockwise by the closing operation of the switch mechanism 15, and therefore the moving arcing contact 9 comes in contact with the stationary arcing contact 5 at first, whereby an electric current can conduct. When the moving contact 6 is further pushed by the switch mechanism 15 and comes in contact with the stationary contact 3, the moving member 7 rotates counterclockwise, the moving arcing contact 9 moves away from the stationary arcing contact 5, and the electric conduction shifts to the moving contact 6 and the stationary contact 3.

[0011] In the conventional air circuit breaker as described above, the arc generated at the time of turning

off shifts to the moving arcing contact 9 and the stationary arcing contact 5, and the arc is induced and extinguished by the arc suppressor 17. Therefore, for the purpose of resisting to the wear due to arc spark generated at the time of turning off and preventing an arcing contact from being welded described later, it is necessary to use contacts made of a tungsten-silver alloy as the stationary arcing contact 5 and the moving arcing contact 9.

[0012] The present invention was made to solve such a problem and has an object of providing an air circuit breaker at a reasonable cost, in which it is not necessary to use any contact made of a tungsten-silver alloy as the arcing contact through which an arc is induced by the arc suppressor 17, an arc is easily suppressed by current-limiting, and welding of the arcing contacts hardly occurs.

Disclosure of Invention

[0013] An air circuit breaker according to the invention includes: a stationary contact fixed on a stationary conductor; a moving member onto which a moving contact that is connected and disconnected with the mentioned stationary contact is fixed; a switch mechanism that opens and closes the moving member by osc illation; a stationary arcing contact disposed at an end portion of a stationary arcing conductor extending from the stationary conductor through a first resistor; and a moving arcing contact disposed at an end portion of a moving arcing conductor extending from the moving member through a second resistor, and

in which when the switch mechanism switches on the moving member, the moving arcing contact comes in contact with the stationary arcing contact, and after bringing the moving contact into contact with the stationary contact, the moving arcing contact moves away from the stationary arcing contact; and when the switch mechanism switches off the moving member, the moving arcing contact comes in contact with the stationary arcing contact, and after moving the moving contact away from the stationary contact, the moving arcing contact is connected and disconnected with the stationary arcing contact by oscillation.

[0014] It is preferable that the resistor is disposed either on the moving member side or on the stationary conductor side.

Brief Description of Drawings

[0015]

Fig. 1 is a sectional view of an essential part of an air circuit breaker according to the present invention.

Fig. 2 is a perspective view of a current-carrying part of the air circuit breaker according to the invention.

Figs. 3 (A), (B) and (C) are explanatory views to explain opening and closing operation of the air circuit breaker according to the invention.

Fig. 4 is a side sectional view of an air circuit breaker according to a prior art.

Best Mode for Carrying Out the Invention

Embodiment 1.

[0016] Fig. 1 is a sectional view of an essential part of an air circuit breaker according to the present invention, Fig. 2 is a perspective view of a current-carrying part of the air circuit breaker according to the invention, and Figs. 3 (A), (B) and (C) are explanatory views to explain opening and closing operation of the air circuit breaker according to the invention.

[0017] In the drawings, reference numerals 1 to 4, 6 to 8, and 10 to 17 are the same as those in the above-mentioned conventional air circuit breaker, and further explanation of them is omitted here. Numeral 4a is a stationary arcing contact formed at an end portion of the stationary arcing conductor 4, and numeral 31 is a first resistor held in a conductible manner between the stationary conductor 2 and the stationary arcing conductor 4. Numeral 8a is a moving arcing contact formed at an end portion of the moving arcing conductor 8, and numeral 32 is a second resistor arranged in a conductible manner between the moving member 7 and the moving arcing conductor 8.

[0018] Operation of the air circuit breaker according to the invention is hereinafter described with reference to Figs. 3 (A), (B) and (C). Fig. 3 (A) shows a state that the air circuit breaker is on. Referring to the drawing, the moving contact 6 is in contact with the stationary contact 3, and the moving arcing contact 8a is spaced away from the stationary arcing contact 4a. In this state, the electric current flows in order through the stationary conductor 2, the stationary contact 3, the moving contact 6, the moving member 7, the flexible conductor 13, and the terminal conductor 12.

[0019] When starting an interrupting operation upon detection of any excessive current, the switch mechanism 15 raises the shaft 16, and the moving member 7 turns clockwise by the urging force of the contact pressure spring 14. Accordingly, the moving contact 6 is slightly moved away from the stationary contact 3 and the electric current flows between the two contacts through an arc. When turning the moving member 7 further, the moving arcing contact 8a comes in contact with the stationary arcing contact 4a as shown in Fig. 3 (B). In this state, the current flows in order through the stationary conductor 2, the first resistor 31, the stationary arcing conductor 4, the stationary arcing contact 4a, the moving arcing contact 8a, the moving arcing conductor 8, the second resistor 32, the moving member 7, the flexible conductor 13, and the terminal conductor 12. Resistance of the first resistor 31 and the second resistor 32 interposed in the mentioned current flow limits the

conduction of current.

[0020] As a result of this current-limiting action, while an accidental electric current and so on being limited, the moving arcing contact 8a moves away from the stationary arcing contact 4a as shown in Fig. 3 (C). In this state, an arc is generated between the stationary arcing contact 4a and the moving arcing contact 8a. However, since the arc energy is reduced as a result of limiting the electric current, the arc is suppressed easily.

[0021] Welding of the contacts may occur at the time of turning on under the condition that a considerable large amount of current is flowing through the mentioned air circuit breaker. This welding is reduced according to the construction of the invention. The reason is now described below. By the closing operation of the switch mechanism 15, first themoving arcing contact 8a comes in contact with the stationary arcing contact 4a, whereby a current flows between the two contacts.

[0022] The two contacts are slightly opened due to impact and repulsion at the time of the closing operation, and the current flowing through this opening generates an arc. This arc has a high temperature that melts surface of the two contacts. In such a state, when the two contacts are connected again and the arc is extinguished, the molten portions on the surface of the contacts are cooled, and the welding occurs. In order to cope with this phenomenon, silver alloy contacts that hardly melt have been conventionally used in the art.

[0023] On the other hand, in the construction of the invention, the moving member 7 is arranged to oscillate at the time of on-off operation. Therefore, the current that flows when the moving arcing contact 8a comes in contact with the stationary arcing contact 4a is limited by the first resistor 31 and the second resistor 32, whereby the arc energy that causes welding is reduced.

[0024] Even if welding occurs at the portion where the moving arcing contact 8a is in contact with the stationary arcing contact 4a, the moving member 7 is pushed down counterclockwise using the contact portion as a fulcrum until the moving contact 6 comes in contact with the stationary contact 3, and therefore the contact portion once welded is separated by the action of levers. When the moving contact 6 comes in contact with the stationary contact 3, the current shifts to the moving contact 6 and the stationary contact 3 where resistance is small and, subsequently, the portion where the moving arcing contact 8a is in contact with the stationary arcing contact 4a is separated. As a result, this portion is free from generation of any arc, and wear of the two contacts caused by an arc does not take place.

[0025] It is, therefore, possible to employ any conductive material mainly composed of copper as the stationary arcing conductor 4 including the stationary arcing contact 4a and the moving arcing conductor 8 including the moving arcing contact 8a. Consequently, it is not necessary to use any arc contact made of a tungsten-silver alloy.

[0026] It is also preferable that the first resistor 31 and the second resistor 32 are made of sheet steel having a specific resistance higher than that of a copper material instead of a specific resistance alloy.

[0027] Although both stationary arcing conductor 4 and moving arcing conductor 8 are provided with the first resistor 31 and the second resistor 32 respectively in the foregoing description, it is a matter of course that the same advantage is obtained in the case that either conductor is provided with a resistor.

Industrial Applicability

[0028] As described above, the air circuit breaker according to the invention is provided with a switch mechanism 15 that opens and closes a moving member 7 in an oscillating manner, a first resistor 31 interposed between a stationary conductor 2 and a stationary arcing contact 4a, and a second resistor 32 interposed between a moving member 7 and a moving arcing contact 8a. In this circuit breaker, when the switch mechanism 15 switches on the moving member 7, a moving contact 6 comes in contact with a stationary contact 3 while keeping the moving arcing contact 8a in contact with the stationary arcing contact 4a, and thereafter the moving arcing contact 8a moves away from the stationary arcing contact 4a, and when the switch mechanism 15 switches off the moving member 7, the moving arcing contact 8a comes in contact with the stationary arcing contact 4a, and after the moving contact 6 moves away from the stationary contact 3, the moving arcing contact 8a is connected and disconnected with the stationary arcing contact 4a in an oscillating manner. As a result, an electric current flowing through the two contacts at the time of opening and closing is limited by the first resistor 31 and the second resistor 32, thereby facilitating extinction of arc and preventing welding of the arcing contacts, and consequently, it is no more required to employ any contact made of a tungsten-silver alloy as the arcing contacts, which makes it possible to obtain an air circuit breaker at a reasonable cost.

Claims

1. An air circuit breaker comprising:

a stationary contact fixed on a stationary conductor;
a moving member onto which a moving contact that is connected and disconnected with said stationary contact is fixed;
a switch mechanism that opens and closes said moving member by oscillation;
a stationary arcing contact disposed at an end portion of a stationary arcing conductor extending from said stationary conductor toward an arc suppressor through a first resistor; and
a moving arcing contact disposed at an end

portion of a moving arcing conductor extending from said moving member toward said arc suppressor through a second resistor;

characterized in that when the switch mechanism switches on said moving member, said moving arcing contact comes in contact with said stationary arcing contact, and after bringing said moving contact into contact with said stationary contact, said moving arcing contact moves away from said stationary arcing contact; and when said switch mechanism switches off said moving member, said moving arcing contact comes in contact with said stationary arcing contact, and after moving said moving contact away from said stationary contact, said moving arcing contact moves away from said stationary arcing contact by oscillation.

2. The circuit breaker according to claim 1, wherein the resistor is disposed either on the moving member side or on the stationary conductor side.

Fig. 1

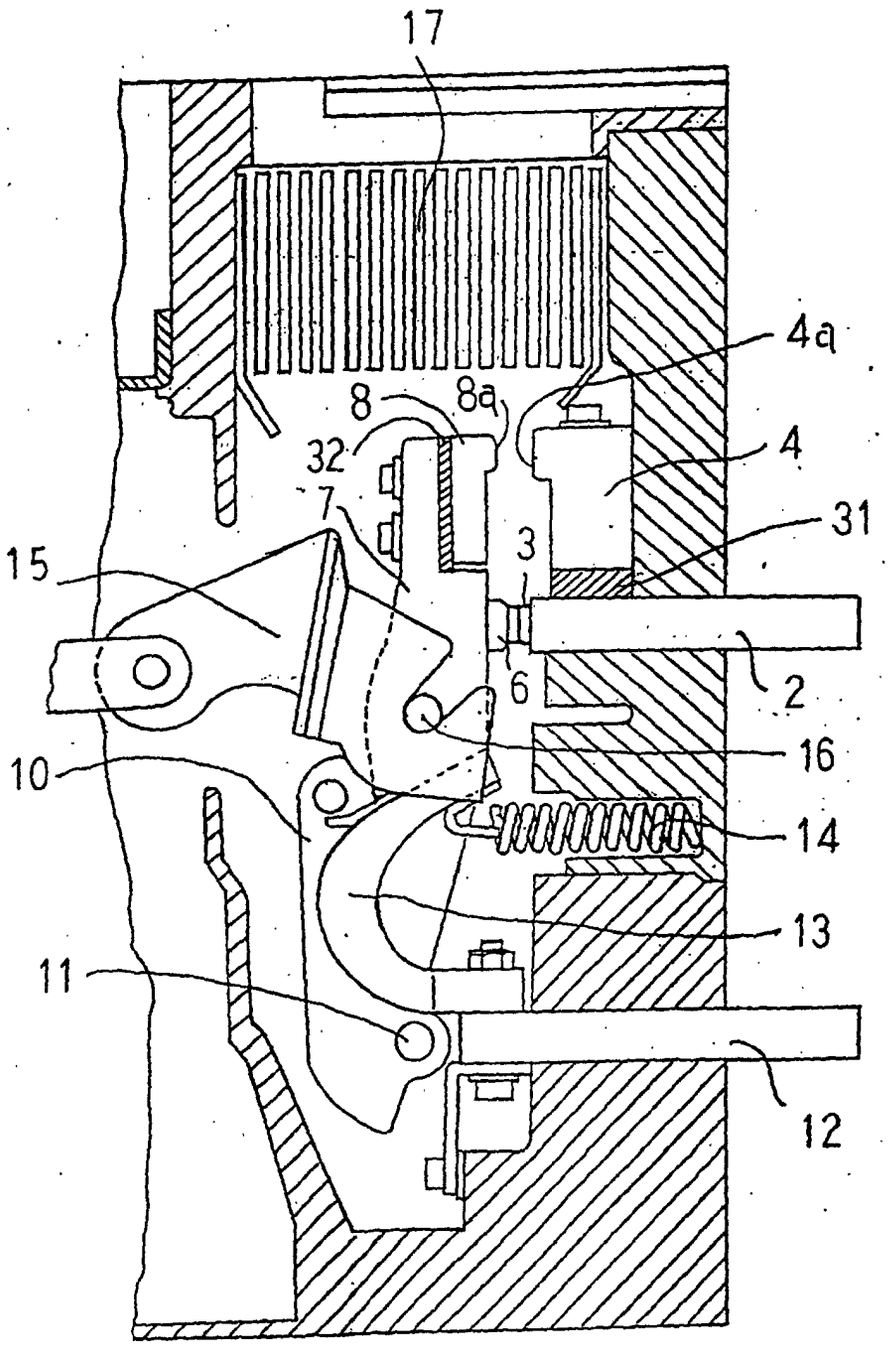


Fig. 2

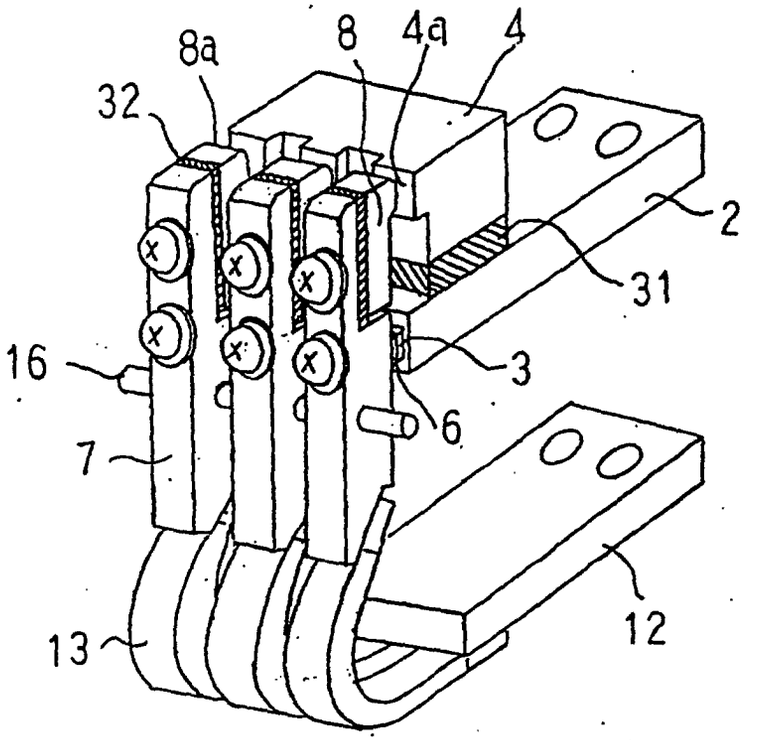
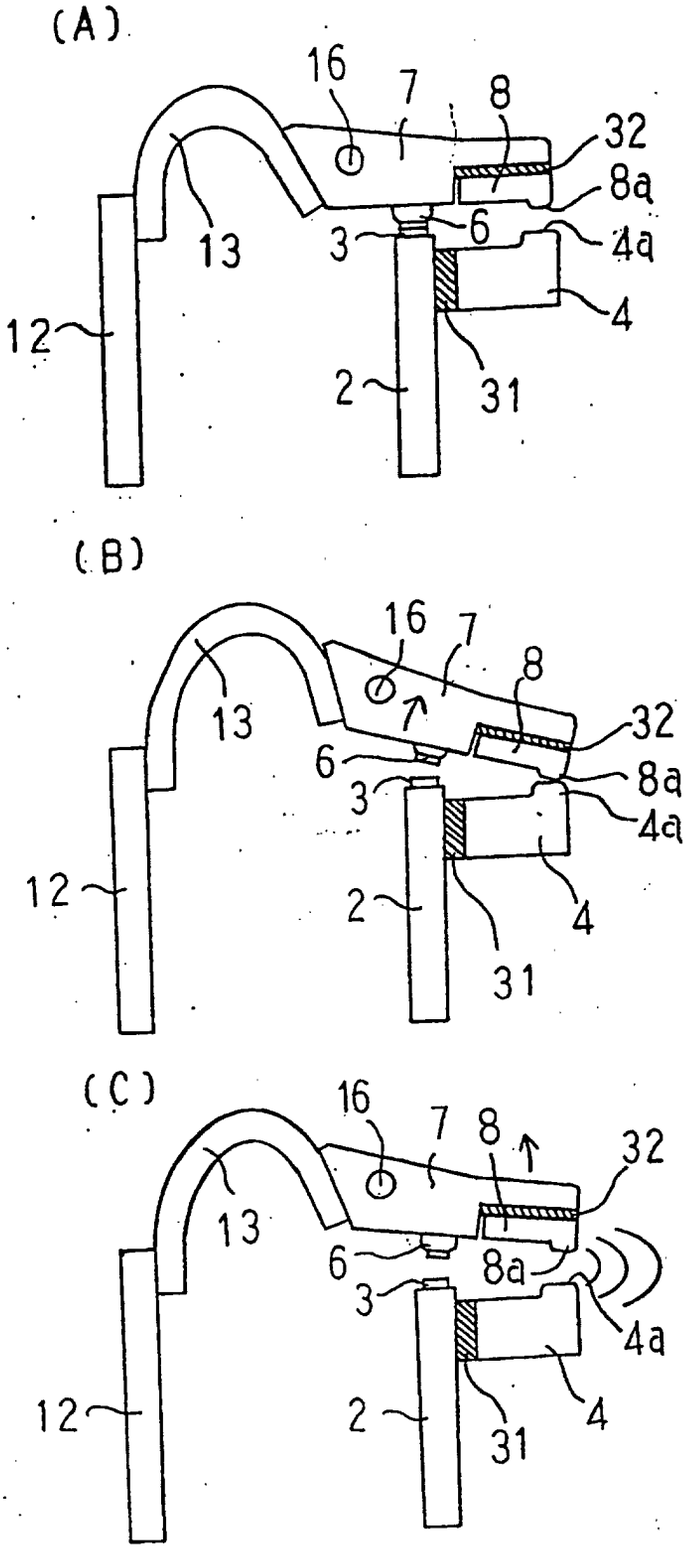


Fig. 3


(A)
16
7
8
32
8a
13
3
6
4a
12
4
2
31
(B)
16
7
8
13
32
6
8a
3
4a
12
2
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16
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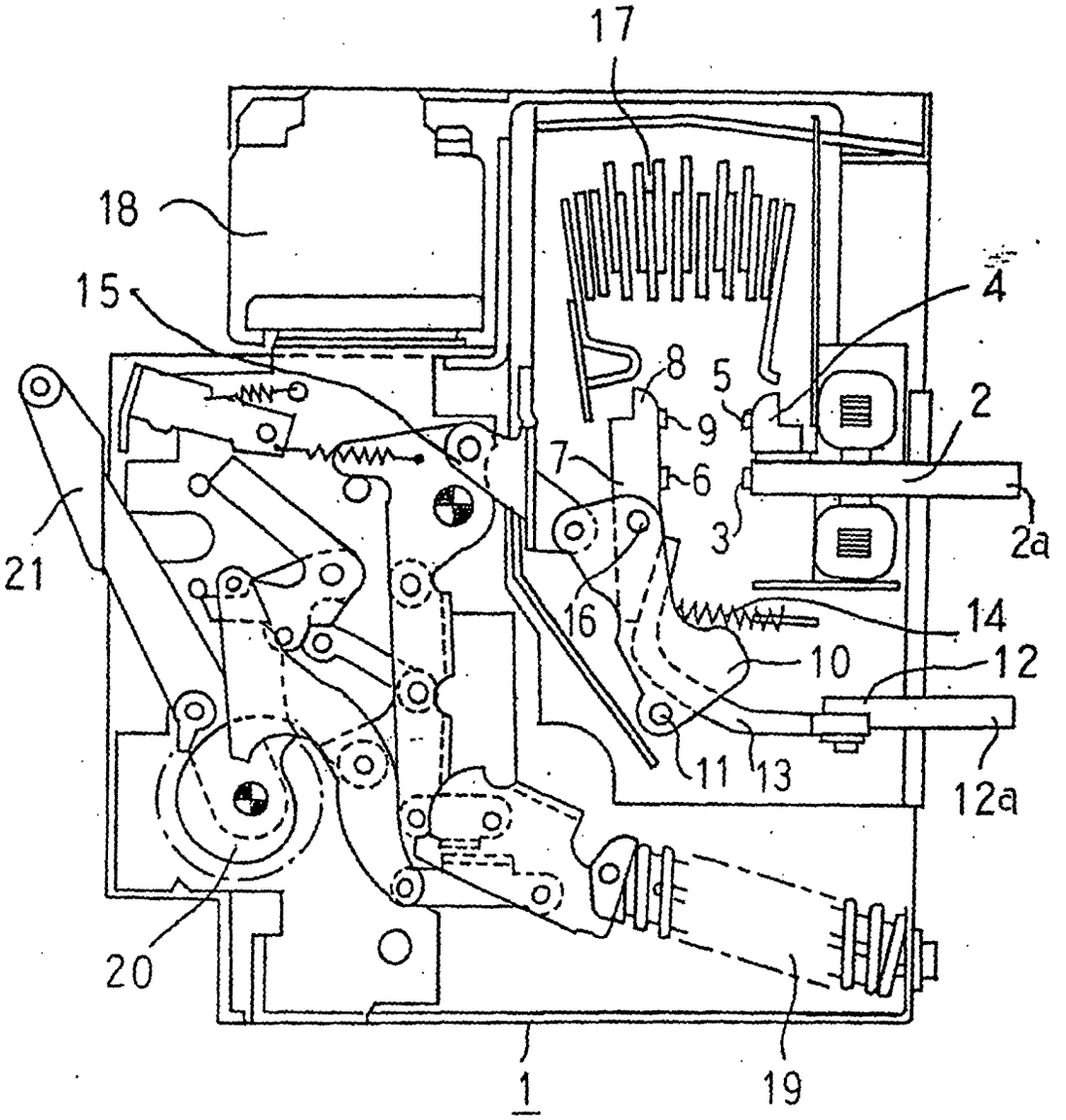
3
4a
12
2
4
31

Fig. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/01623

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H01H33/08

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] H01H33/08-33/12

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

Jitsuyo Shinan Koho	1940-1996	Toroku Jitsuyo Shinan Koho	1994-2002
Kokai Jitsuyo Shinan Koho	1971-2002	Jitsuyo Shinan Toroku Koho	1996-2002

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2-90422 A (Mitsubishi Electric Corp.), 29 March, 1990 (29.03.90), Full text; Figs. 1 to 5 (Family: none)	1,2
A	JP 2-90423 A (Mitsubishi Electric Corp.), 29 March, 1990 (29.03.90), Full text; Figs. 1 to 5 (Family: none)	1,2
A	JP 3-11511 A (Mitsubishi Electric Corp.), 18 January, 1991 (18.01.91), Full text; Figs. 1 to 6 (Family: none)	1,2

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

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
16 April, 2002 (16.04.02)	30 April, 2002 (30.04.02)
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Facsimile No.	Telephone No.

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