(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 232 473 B1**

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **29.05.91**

(51) Int. Cl.[5]: **H01H 73/04**

(60) Publication number of the earlier application in accordance with Art.76 EPC: **0 061 097**

(21) Application number: **86115277.5**

(22) Date of filing: **12.03.82**

(54) A circuit breaker.

(30) Priority: **12.03.81 JP 35552/81 U**
12.03.81 JP 35554/81 U
12.03.81 JP 35555/81 U
12.03.81 JP 35556/81 U
12.03.81 JP 35557/81 U

(43) Date of publication of application:
19.08.87 Bulletin 87/34

(45) Publication of the grant of the patent:
29.05.91 Bulletin 91/22

(84) Designated Contracting States:
CH DE FR GB IT LI

(56) References cited:
EP-A- 0 054 833
DE-A-29 288 23
DE-B- 1 765 050
US-A- 3 127 488
US-A- 3 402 273
US-A- 3 997 746

(73) Proprietor: **MITSUBISHI DENKI KABUSHIKI KAISHA**
2-3, Marunouchi 2-chome Chiyoda-ku
Tokyo 100(JP)

(72) Inventor: **Yamagata, Shinji**
2-20-2, Nogami-cho
Fukuyama Hiroshima Prefecture(JP)
Inventor: **Hisatsune, Fumiyuki**
327-8, Daimon-cho Daimon
Fukuyama Hiroshima Prefecture(JP)
Inventor: **Terachi, Junichi**
211, Kasuga-dai
Fukuyama Hiroshima Prefecture(JP)
Inventor: **Yoshiyasu, Hajimu**
11-2, Minami Nanryo-cho
Itami Hyogo Prefecture(JP)

(74) Representative: **Kern, Ralf M., Dipl.-Ing.**
Postfach 14 03 29
W-8000 München 5(DE)

EP 0 232 473 B1

Description

The present invention relates to a circuit breaker as stated within the preamble of claim 1.

A circuit breaker of this type is already known from DE-A-2928823. From US-A-3402273 it is further known to provide arc shields which cover the rigid conductors thereby surrounding the contacts.

In view of this prior art it is the object of the present invention, to provide a circuit breaker which has improved current limiting characteristics thus allowing a reduction of the overall size of such a circuit breaker.

In accordance with the invention, this object can be obtained by providing the features as stated within the characterizing clause of claim 1.

Further improvements of the invention can be obtained by the features, as stated within the subclaims.

The circuit breaker of the invention is so constructed as to increase the separating speed of its contacts and to effectively increase the arc voltage of an electric arc struck across the contacts to thus attain an enhanced current-limitingperformance. The particular circuit breaker is provided with arc shields of a high resistivity material in a manner to surround the contacts. Owing to the arc shields, the feet of an electric arc are prevented from spreading to the parts of the rigid conductors near the contacts, thereby to effectively inject the metal particles of the contacts into the arc and to raise the arc voltage of the electric arc, while at the same time the pressure within the space of the electric arc is increased, so that the separating speed of the contacts can be inproved.

Preferred ways of carrying out the invention are described in detail below with reference to drawings, in which:

- Fig. 1a is a sectional plan view showing an embodiment of the circuit breaker according to the present invention,
- Fig. 1b is a sectional side view taken along line b - b in Fig. 1a and showing the state in which the contacts of the circuit breaker are disengaged,
- Fig. 2 is a sectional side view showing the state in which the contacts of the circuit breaker in Fig. 1b are engaged, and
- Fig. 3 is a sectional side view showing the state in which the contacts of the circuit breaker in Fig. 1b have started to separate.

In the drawings, the same symbols indicate identical or corresponding parts.

Fig. 1a and 1b show an embodiment of the invention wherein an enclosure 1 made of an insulator forms the outer frame of a switching device and is provided with an exhaust port 101. A first contactor 2 ist constructed of a first rigid conductor 201 which is turnably supported by a pivot pin 2b on a holder 2a fixed to the enclosure 1, and a first contact 202 which is mounted on one end part of the first rigid conductor 201. The first rigid conductor 201 is connected to a connection terminal 204 through a flexible conductor 203. A second contactor 3 being movable relative to the first contactor 2 in order to close or open the circuit breaker, is constructed of a second rigid conductor 301 which is operated relative to the first rigid conductor 201 so as to close or open the circuit breaker, and a second contact 302 which is mounted on one end part of the second rigid conductor 301 in manner to confront the first contact 202. The second rigid conductor 301 is connected to an external conductor (not shown) through a flexible conductor 303, and the intermediate part thereof is turnably held on one end part of a movable frame member 304 by a pivot pin 305. A cross bar 306 is mounted on the other end part of the movable frame member 304 in a direction perpendicular to the plane of the drawing, and acts to move the movable frame member simultaneously in each phase. A torsion spring 307 is applied to the pivot pin 305 and has its respective end parts held in engagement with the second rigid conductor 301 and the movable frame member 304. A spring 2A being interposed between the first rigid conductor 201 and the enclosure 1 urges the first contact 202 against the second contact 302. An operating mechanism 4 operates the second contactor 3 in order to close or open the circuit breaker, and is formed so that one end part of a lower link 401 constituting a linkage is turnably coupled to the second rigid conductor 301 by the pivot pin 305, that one and part of an upper link 402 is turnably coupled to the other end part of the lower link 401 by a pivot pin 403, and that an operating handle 414 is turnably coupled to the other end part of the upper link 402 by a pivot pin (not shown). Arc extinguishing plates 5 to extinguish an electric arc struck when the second contact 302 is separated from the first contact 202 are supported by a pair of side plates 501 and 502.

In addition there are provided arc shields 6 and 7 made of high resistivity material. These arc shields 6, 7 are mounted on the first and second rigid conductors 201 and 301 in a manner to have the first and second contacts 202 and 302 passing therethrough and to oppose to the electric arc. Except for a part of the electrically contacting surface of either contact of the circuit breaker, the part of a rigid conductor adjacent to the contact as projects to the surrounding space is concealed behind these arc shields 6, 7 which are plate-shaped pressure reflectors or a covering such as

taping and coating. These arc shields 6, 7 are made of a substance of a highly resistive material having a resistivity higher than that of a material forming the rigid conductor, thereby to forcibly inject metal particles into an arc space, so that the electrodes are separated at high speed by a high pressure established owing to the provision of the arc shields. As high resistivity material, there can be used, for example, an organic or inorganic insulator, or a high resistivity metal such a copper-nickel, copper-manganese, manganin, iron-carbon, iron-nickel or iron-chromium. It is also possible to use iron whose resistance increases abruptly in accordance with a temperature rise.

When the operating handle 404 is turned clockwise, the first and second contacts 202 and 302 are engaged as illustrated in Fig. 2. When a high current, such as a short-circuit current flows in this state, the first and second rigid conductors 201 and 301 are repelled electromagnetically. Therefore the first rigid conductor 201 is separated a illustrated in Fig. 3, so that the electric arc A develops between the first and second contacts 202 and 302. Subsequently, the operating mechanism 4 works to completely separate the second rigid conductor 301. Within the arc A itself metal particles of the contacts are reflected by the arc shields 6 and 7 to render the pressure of the arc space high, with the result that the arc is effectively cooled and extinguished.

In accordance with the described embodiment, the first rigid conductor 201 is turnably held on the movable frame member 304 by the pivot pin 305, whereby in addition the arc shields 6 and 7 are provided. Although the operating mechanism 4 leads to a low separating speed of the movable rigid conductor 201 on account of its inertia, the pressure of the space Q between the arc shields 6 and 7 becomes very high so that the movable rigid conductor 201 is separated at very high speed without waiting for the drive of the operating mechanism 4. In consequence, the rise of the arc voltage immediately after the separation is rapid, so that the peak value of the current flowing through the circuit can be suppressed. At the same time there is the effect of narrowing the arc A by the arc shields 6 and 7, so that a high current-limiting effect can be attained. The construction of the circuit breaker is such that, when a comparatively great current flows, no current separation takes place, because the repulsion forces between the first and second contacts 202 and 302 are kept relatively small.

In case, that such a circuit breaker is used for alternating currents, the polarity of the current on a contact during arcing is not decided, while the polarity of the arc between the contacts changes even during arcing. In this regard, the circuit breaker of the invention can prevent the polarity effect on the current-limiting performance from becoming different depending upon whether the polarity on the contact to be separated by the electromagnetic repellence is a cathode or an anode, and it can stabilize the current-limiting performance. That is, such beneficial result is achieved by the measure that both the first rigid conductor 201 and the second rigid conductor 301 on which the first contact 202 and the second contact 302 are respectively mounted are formed of the turnable electromagnetic repulsion type.

Claims

1. Circuit breaker comprising an operating mechanism (4) to close or open an electric circuit by engaging or disengaging a pair of contacts (202, 302), said pair of contacts (202, 302) being disposed on current conducting conductors (201, 301) of which both of these conductors (201, 301) are pivotally supported in order to be able to move to and from the opposite contact (302, 202) and the first conductor (201) being pivotally mounted on the circuit breaker's enclosure (1) and additionally provided with a spring (2A) urging said first conductor (201) into the direction towards the second conductor (301)
characterized in
   - that arc shields (6, 7) are disposed on said conductors (201, 301) in a way as to surround said contacts (202, 302)
   - that said second conductor (301) is provided with a spring (307) loaded pivot (305) and is turnably held to said operating mechanism (4) by said pivot (305) thereby being only supported by said operating mechanism (4) and
   - that said first conductor (201) and said second conductor (301) are arranged relative to each other in a way that only said contacts (202, 302) and said respective arc shields (6, 7) are facing each other in the closed state.

2. Circuit breaker according to claim 1, characterized in that both the first and second conductors (201, 301) are connected to external terminals via flexible conductors (203, 303).

3. Circuit breaker according to claim 1 or 2, characterized in that at least one of the arc shields (6, 7) is provided with a groove or an arc run way extending from the respective contact (202, 302) towards arc extinguishing plates (5)

thereby exposing the respective conductor (201, 301).

4. Circuit breaker according to any one of the claims 1-3, characterized in that the arc shields (6, 7) surrounding the peripheries of the first and second contacts (202, 302) and concealing parts of the first and second conductors (201, 301) adjacent to these contacts (202, 302) are made of high resistivity materials.

5. Circuit breaker according to claim 4, characterized in that the high resistivity material of the arc shields (6, 7) is an organic or inorganic insulator.

6. Circuit breaker according to claim 4, characterized in that the high-resistivity material of the arc shields (6, 7) is a high resistivity metal such as copper-nickel, copper-manganese, manganin, iron-carbon, iron-nickel, iron-chromium or iron.

Revendications

1. Coupe-circuit comprenant un mécanisme d'actionnement (4) pour fermer ou ouvrir un circuit électrique, en engageant ou désengageant une paire de contacts (202,302) ladite paire de contacts (202, 302) étant disposée sur des conducteurs conduisant le courant (201, 301), dont deux de ces conducteurs (201, 301) sont supportés de façon pivotante afin de pouvoir se déplacer vers le contact opposé (302,202) et de celui-ci et le premier conducteur (201) étant monté de façon pivotante sur l' enceinte (1) du coupe-circuit, et de plus pourvu d'un ressort (2A) sollicitant le premier conducteur (201) dans la direction vers le second conducteur (301)
caractérisé en ce que
   - des protections contre l'arc (6, 7) sont disposées sur les conducteurs (201, 301) d'une manière à entourer les contacts (202, 302)
   - le second conducteur (301) est pourvu d'un pivot (305) chargé par un ressort (307) et est maintenu de façon pivotante au mécanisme d'actionnement (4) par ledit pivot (305), étant de la sorte seulement supporté par le mécanisme d'actionnement (4) et
   - le premier conducteur (201) et le second conducteur (301) sont agencés l'un par rapport à l'autre d'une manière que seulement lesdits contacts (202, 302) et les protections respectives contre l'arc (6, 7) se font face les uns par rapport aux autres à l'état fermé.

2. Coupe-circuit selon la revendication 1, caractérisé en ce que les premier et second conducteurs (201, 301) sont tous les deux reliés à des bornes externes par l'intermédiaire de conducteurs flexibles (203, 303).

3. Coupe-circuit selon la revendication 1 ou 2, caractérisé en ce qu'au moins l'une des protections contre l' arc (6, 7) est pourvue d'une gorge ou d'un chemin de guidage de l'arc s'étendant du contact respectif (202, 302) vers des plaques d'extinction de l'arc (5), exposant de la sorte le conducteur respectif (201, 301).

4. Coupe-circuit selon l'une des revendications 1-3, caractéirisé en ce que les protections contre l'arc (6, 7) entourant les périphéries des premier et second contacts (202, 302) et des parties de dissimulation des premier et second conducteurs (201, 301) adjacentes à ces contacts (202, 302) sont réalisées en matériaux à résistivité élevée.

5. Coupe-circuit selon la revendication 4, caractérisé en ce que le matériau à résistivité élevée des protections contre l'arc (6, 7) est un isolant organique ou inorganique.

6. Coupe-circuit selon la revendication 4, caractérisé en ce que le matériau à résistivé élevée des protections contre l'arc (6, 7) est un matériau à résistivité élevée tel que du cuivre-nickel, du cuivre-manganèse, de la manganine, du fer-carbone, du fer-nickel, du fer-chrome ou du fer.

Ansprüche

1. Stromunterbrecher mit einem Betätigungsmechanismus (4), mit welchem ein elektrischer Stromkreis durch Kontaktbildung oder Kontaktlösung eines Paars von Kontakten (202, 302) geschlossen bzw. geöffnet wird, wobei diese beiden Kontakte (202, 302) jeweils auf stromleitenden schwenkbaren Leitern (201, 301) angeordnet sind, um auf diese Weise eine Annäherung oder Entfernung gegenüber dem jeweils gegenüberliegenden Kontakt (302, 202) zu ermöglichen, und wobei der erste Leiter (201) an dem Gehäuse (1) des Stromunterbrechers schwenkbar gelagert ist und zusätzlich unter dem Einfluß einer Feder (2A) steht, welche den ersten Leiter (201) in Richtung des zweiten Leiters (301) drückt, dadurch **gekenn-**

zeichnet,

- daß auf den beiden Leitern (201, 301) Lichtbogenschilde (6, 7) derart angeordnet sind, daß dieselben die Kontakte (202. 302) umgeben,
- daß der zweite Leiter (301) mit einem unter dem Einfluß einer Feder (307) stehenden Gelenk (305) versehen ist und dabei mit Hilfe dieses Gelenkpunktes (305) von dem Betätigungsmechanismus (4) schwenkbar gehalten ist, so daß dieser Leiter (301) nur von dem Betätigungsmechanismus (4) gehalten wird und
- daß der erste Leiter (201) und der zweite Leiter (301) derart relativ zueinander angeordnet sind, daß im geschlossenen Zustand nur die Kontakte (202, 302) und die entsprechenden Lichtsbogenschilde (6, 7) einander gegenüberstehen.

2. Stromunterbrecher nach Anspruch 1, dadurch gekennzeichnet, daß die ersten und zweiten Leiter (201, 301) über biegsame Leiter (203, 303) mit entsprechenden Anschlußklemmen verbunden sind.

3. Stromunterbrecher nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß wenigstens eines der Lichtbogenschilde (6, 7) mit einer Rinne bzw. einem Lichtbogenlaufpfad versehen ist, welcher sich von dem entsprechenden Kontakt (202, 302) in Richtung der Lichtbogenlöschplatten (5) erstreckt, wodurch der entsprechende Leiter (201, 301) freigelegt ist.

4. Stromunterbrecher nach einem der Ansprüche 1 bis 3, dadurch kennzeichnet, daß die die Umfangsbereiche der beiden Kontakte (202, 302) umgebenden gewisse Teile der ersten und zweiten Leiter (201, 301) in der Nähe der Kontakte (202, 302) abdeckenden Lichtbogenschilde (6, 7) aus einem Material mit hohem elektrischen Widerstand hergestellt sind.

5. Stromunterbrecher nach Anspruch 4, dadurch gekennzeichnet, daß das Material hohen elektrischen Widerstands der Lichtbogenschilde (6, 7) ein organischer oder inorganischer Isolator ist.

6. Stromunterbrecher nach Anspruch 4, dadurch gekennzeichnet, daß das Material hohen elektrischen Widerstands der Lichtbogenschilde (6, 7) ein Metall mit hohem elektrischen Widerstand, beispielsweise Kupfer-Nickel, Kupfer-Mangan, Manganin, Eisen-Carbon, Eisen-Nikkel, Eisen-Chrom oder Eisen ist.

FIG. 1(a)

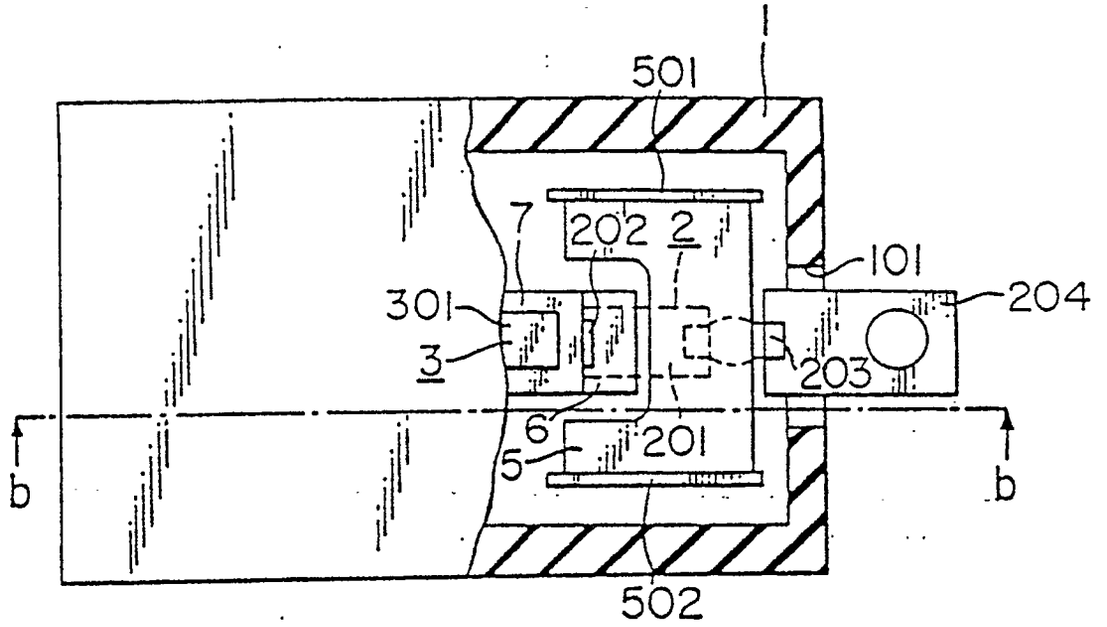

1
501
7
202
2
101
204
301
3
203
6
201
5
b
b
502

FIG. 1(b)

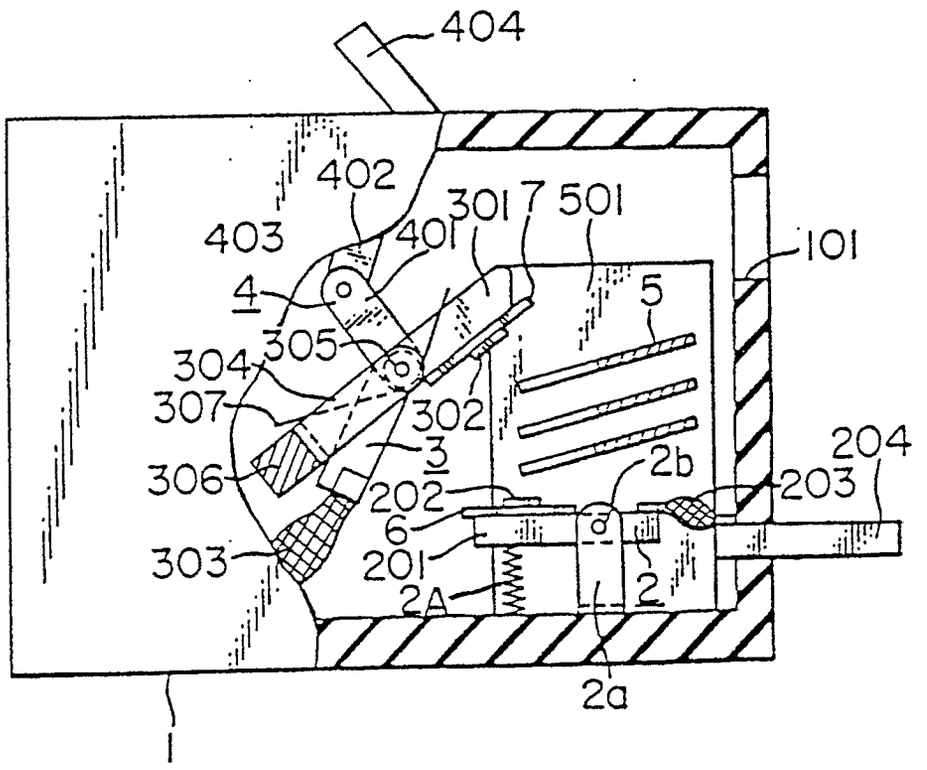

404
402
403
401
301
7
501
101
4
5
305
304
307
302
3
306
202
2b
204
203
6
303
201
2A
2
2a
1

FIG. 2

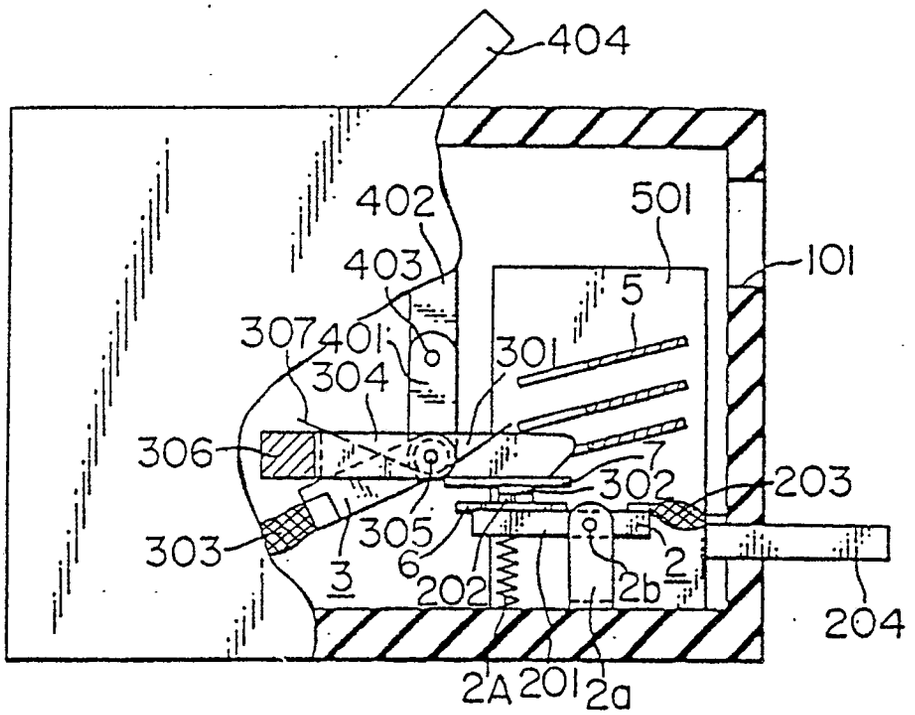
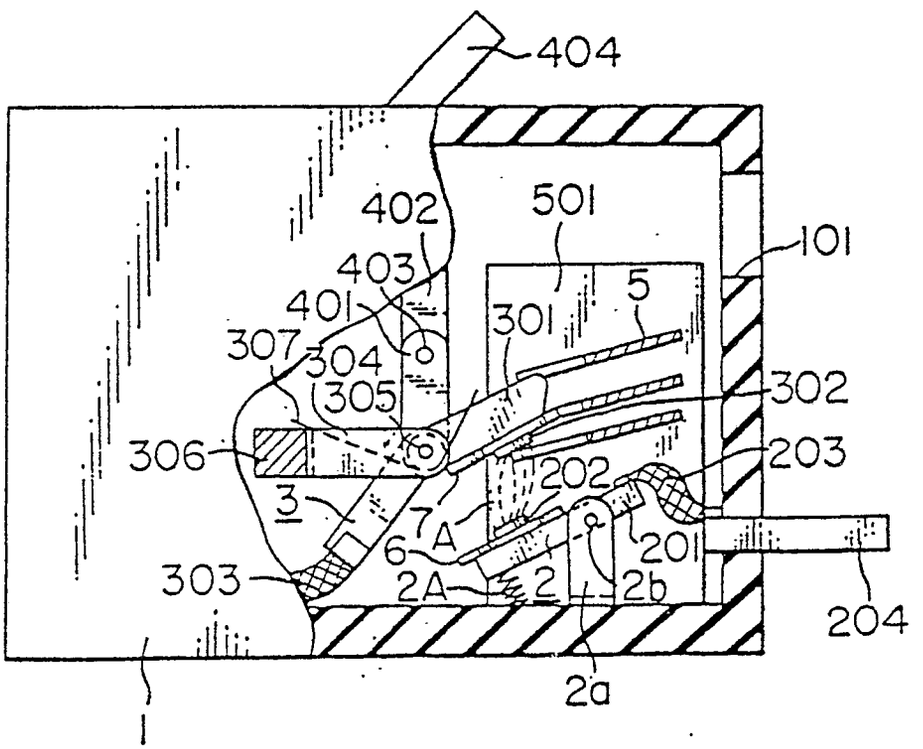

404
402
501
403
101
5
307
401
301
304
306
302
203
303
305
6
3
202
2b
2
204
2A
201
2a

FIG. 3


404
402
501
101
403
5
401
301
307
304
302
305
306
203
202
3
7A
6
201
303
2A
2
2b
204
2a
1