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

(11) **EP 2 709 133 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
18.01.2017 Bulletin 2017/03

(21) Application number: **13183857.5**

(22) Date of filing: **11.09.2013**

(51) Int Cl.:
H01H 9/32 *(2006.01)* ***H01H 9/06*** *(2006.01)*
H01H 13/08 *(2006.01)*

(54) Trigger switch and power tool

Kippschalter und elektrisches Werkzeug

Déclencheur et outil électrique

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **13.09.2012 JP 2012201425**

(43) Date of publication of application:
19.03.2014 Bulletin 2014/12

(73) Proprietor: **Panasonic Intellectual Property Management Co., Ltd.**
Osaka 540-6207 (JP)

(72) Inventors:
- **Tsuruta, Naoki**
  Chuo-ku, Osaka 540-6207 (JP)
- **Ikeda, Masaki**
  Chuo-ku, Osaka 540-6207 (JP)

(74) Representative: **Appelt, Christian W.**
Boehmert & Boehmert
Anwaltspartnerschaft mbB
Patentanwälte Rechtsanwälte
Pettenkoferstrasse 20-22
80336 München (DE)

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Description

[0001] The present invention relates to a trigger switch and a power tool.

[0002] Japanese Laid-Open Patent Publication No. 2006-221908 describes an example of a known trigger switch that is operated by a user. Such a trigger switch may be employed in a power tool or the like. When the user pulls a trigger, two contacts come into contact with each other, and power is supplied via the contacts to a load such as a motor.

[0003] In such a trigger switch, the separation of the contacts stops the supply of power to the load. However, depending on the separated distance, arcs may be produced between the contacts. Such arcs may form a fibrous conductor. In such a case, even when the trigger switch is deactivated, that is, even when the contacts are separated, the fibrous conductor may continuously supply the load with power.

[0004] Document DE 197 26 402 A1 discloses an electric device comprising a contact system consisting of a fixed contact and of a switching contact, an actuating member for triggering a switching operation, and a shield which is rotatably mounted in the housing.

[0005] Accordingly, it is an object of the present invention to provide a trigger switch and a power tool that stops the supply of power to a load when the switch is deactivated.

[0006] One aspect of the present invention is a trigger switch including two contacts that are used to supply power to a load. An anti-conduction portion is arranged between the two contacts when the trigger switch is deactivated. The anti-conduction portion is moved away from between the two contacts when the trigger switch is activated.

[0007] The trigger switch further includes a trigger adapted to be pulled by a user. The anti-conduction portion is moved away from between the two contacts when the trigger is pulled, wherein the anti-conduction portion is moved away from between the two contacts in the same direction as the pulling direction of trigger.

[0008] A further aspect of the present invention is a power tool including the above trigger switch.

[0009] Other aspects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

[0010] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a schematic diagram of a power tool according to one embodiment of the present invention;
Fig. 2 is a schematic diagram of a trigger switch provided in the power tool shown in Fig. 1;
Fig. 3 is a schematic diagram of the trigger switch provided in the power tool shown in Fig. 1;
Fig. 4 is a schematic diagram illustrating a variable resistor;
Fig. 5 is an electric circuit diagram illustrating the variable resistor; and
Fig. 6 is a graph illustrating the relationship of the pulled amount of a trigger and the output voltage.

[0011] A power tool according to one embodiment of the present invention will now be described with reference to the drawings.

[0012] Referring to Fig. 1, in the present embodiment, a power tool 10 is used as, for example, a drill driver. The power tool 10 includes a main body 11 and a battery pack 12 that is attached in a detachable manner to the main body 11. The main body 11 includes a generally T-shaped case 15. The case 15 includes a cylindrical barrel 13 and a grip 14, which extends downward from a middle portion of the barrel 13. In the present embodiment, the longitudinal direction of the barrel 13 is referred to as the front-to-rear direction. The direction in which the grip 14 extends, that is, the direction orthogonal to the front-to-rear direction, is referred to as the vertical direction. The direction orthogonal to the front-to-rear direction and the vertical direction is referred to as the lateral direction.

[0013] The barrel 13 of the case 15 includes a drive unit 16, which is located somewhat toward the rear from the longitudinally middle portion of the barrel 13. The drive unit 16 mainly includes a motor 16a, which serves as a load, and an output shaft 16b. The motor 16a is accommodated in the barrel 13 so that a distal end of the output shaft 16b faces toward the front of the barrel 13. A drive transmission unit 16c is connected to the distal end of the output shaft 16b. The output shaft 16b includes a speed reduction mechanism, a clutch mechanism, and the like. The drive transmission unit 16c includes a distal end coupled to an output shaft (not shown) in a chuck. A bit (not shown) is coupled in a removable manner to the chuck 17. The motor 16a generates drive power that rotates the bit on the chuck 17.

[0014] As shown in Fig. 1, the grip 14 includes a trigger switch 20.

[0015] Referring to Figs. 2 and 3, the trigger switch 20 includes a main body 21 and a trigger 22, which may be operated by a user. The main body 21 includes a housing 23, which accommodates a support 24 and a plurality of contacts 25. The support 24 supports the trigger 22. The contacts 25 come into contact with each other or are separated from each other in accordance with the movement of the trigger 22.

[0016] The support 24 includes a support body 24a, a slider 24b, and a compression spring 24c. The support body 24a includes a front end coupled to the slider 24b, which is inserted through an opening 23a in the housing 23, and a rear end coupled to the compression spring 24c. The compression spring 24c is arranged between the support body 24a and the wall of the housing 23. The

compression spring 24c urges the support body 24a in one direction (forward direction).

[0017] An L-shaped anti-conduction portion 26 extends from the rear end of the support body 24a. The anti-conduction portion 26 includes a first extension, which downwardly extends from the rear end of the support body 24a, and a second extension, which extends parallel to the support body 24a from the first extension. The anti-conduction portion 26 is formed by a non-conductor.

[0018] The contacts 25 include a fixed contact 25a and a movable contact 25b, which is pivoted (tilted) is cooperation with the operation of the trigger 22.

[0019] The fixed contact 25a is connected to a contact terminal 31. The movable contact 25b is electrically connected to a power terminal 32. The power terminal 32 is electrically connected to a battery pack (not shown). In the housing 23, the power terminal 32 is bifurcated into a pivot support 32a and a spring seat 32b. The pivot support 32a pivotally supports the movable contact 25b. A tensile spring 33 pulls the movable contact 25b toward the fixed contact 25a. The tensile spring 33 includes one end coupled to the spring seat 32b and another end coupled to the movable contact 25b.

[0020] As shown in Fig. 2, the movable contact 25b includes an abutment portion that abuts against a lower surface of the support body 24a when the trigger 22 is in a projected state, that is, when the trigger 22 is not pulled by the user. The abutment portion is L-shaped and includes a first section, orthogonally extending from a basal end of the movable contact 25b, and a second section, orthogonally extending from the first section. The abutment portion abuts against the lower surface of the support body 24a at a joint of the first and second sections. Abutment of the abutment portion against the lower surface of the support body 24a restricts pivoting of the movable contact 25b caused by the tensile spring 33. Under this situation, the movable contact 25b and the fixed contact 25a are separated from each other. Further, the second extension of the anti-conduction portion 26, which moves together with the trigger 22, is arranged between the fixed contact 25a and the movable contact 25b.

[0021] Referring to Fig. 3, when the trigger 22 is pulled, the movable contact 25b moves away from the support body 24a of the support 24. This releases the abutment portion of the movable contact 25b from the support body 24a. By pulling the trigger 22, the anti-conduction portion 26 is moved away from between the movable contact 25b and the fixed contact 25a. That is, the anti-conduction portion 26 is moved in the same direction as the trigger 22. Thus, the tensile spring 33 pivots the movable contact 25b, and the movable contact 25b comes into contact with the fixed contact 25a.

[0022] Referring to Figs. 4 and 5, the trigger switch 20 includes a variable resistor that is configured to have a resistance varied in accordance with the pulled amount (pulled distance) of the trigger 22. The variable resistor is, for example, electrically connected to the contact terminal 31.

[0023] Referring to Figs. 2 to 5, the variable resistor includes a plurality of conductive patterns P and a sliding element S. The conductive patterns P are arranged on the side surface of the support body 24a. The sliding element S is arranged on, for example, the housing 23. The conductive patterns P includes a conductive pattern PA, which has about the same length as the maximum pulled amount of the trigger 22, a conductive pattern PG, which has a ground potential, a conductive pattern PM, which has the maximum output potential, and conductive patterns P1 to P10, which are arranged between the conductive patterns PG and PM. The conductive pattern PA is electrically connected to a control circuit CP arranged in a lower portion of the grip 14.

[0024] As shown in Fig. 4, the sliding element S includes a first sliding portion S1, which is always in contact with the conductive pattern PA, and a second sliding portion S2, which contacts one of the other conductive patterns PG, P1 to P10, and PM. The second sliding portion S2 comes into contact with one of the conductive patterns P, namely, patterns PG, P1 to P10, and PM, which move when the trigger 22 is pulled. The conductive patterns P are arranged next to one another from conductive pattern PG to conductive pattern PM in the order of conductive patterns P1, P2, P3, P4, and so on. The voltage output to the motor 16a increases as the second sliding portion S2 comes into contact with a conductor pattern P located farther from the conductor pattern PG.

[0025] When voltage is applied to the variable resistor and the trigger 22 is operated (pulled), the control circuit CP is provided with an operation signal (output voltage) that is accordance with the pulled amount of the trigger 22. Based on the operation signal from the variable resistor, the control circuit CP executes a control (PWM control) of a drive signal (output voltage) that drives a switching element SW (FET). This controls the rotation speed of the motor 16a. More specifically, an increase in the pulled amount (pulled distance) of the trigger 22 increases the output voltage supplied to the control circuit CP. This increases the rotation speed of the motor 16a.

[0026] The operation of the power tool 10 will now be described.

[0027] When the trigger 22 of the trigger switch 20 is pulled, the anti-conduction portion 26 located between the movable contact 25b and the fixed contact 25a moves toward the rear. Then, the movable contact 25b pivots toward the fixed contact 25a and comes into contact with the fixed contact 25a. This activates the trigger switch 20. Further, as the trigger 22 moves, the conductive patterns P also move toward the rear. This sets the resistance of the variable resistor in accordance with the pulled amount of the trigger 22. As a result, the control circuit CP controls the switching element SW so that the motor 16a is supplied with output voltage corresponding to the resistance of the variable resistor. This drives the motor 16a, and the drive transmission unit 16c transmits the drive power generated by the motor 16a to the chuck 17.

[0028] When the operation of the trigger 22 is completed, that is, when the user releases the trigger 22, the movable contact 25b abuts against the lower surface of the support body 24a. This pivots the movable contact 25b away from the fixed contact 25a and deactivates the trigger switch 20. As the trigger 22 moves toward the front, that is, as the trigger 22 moves away from the housing 23, the anti-conduction portion 26 moves toward the front in the same direction as the trigger 22 and is arranged between the movable contact 25b and the fixed contact 25a. In this manner, when the trigger switch 20 is deactivated, the anti-conduction portion 26 is located between the fixed contact 25a and the movable contact 25b. This obviates the generation of arcs between the fixed contact 25a and the movable contact 25b that would form a fibrous conductor.

[0029] The advantages of the present embodiment will now be described.

(1) The trigger switch 20 includes the anti-conduction portion 26 that moves away from between the two contacts 25 (25a and 25b) when activated. The anti-conduction portion 26 obviates the generation of arcs between the two contacts 25 (25a and 25b) that would form a fibrous conductor.

(2) The anti-conduction portion 26 moves away from between the two contacts 25 (25a and 25b) when the user pulls the trigger 22. In this manner, by pulling the trigger 22, the anti-conduction portion 26 may be moved away from the contacts 25.

(3) The anti-conduction portion 26 moves away from the between the two contacts 25 in a direction that is the same as the direction in which the trigger 22 is pulled. If the anti-conduction portion 26 were moved away from between the two contacts 25 in a different direction, the trigger switch 20 would have to be increased in size in a direction intersecting the trigger pulling direction. This would enlarge the trigger switch 20. However, since the trigger switch 20 is formed so that the anti-conduction portion 26 is moved away from between the two contacts 25 in the same direction as the pulling direction of the trigger 22, enlargement of the trigger switch 20 may be suppressed.

[0030] It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms. Particularly, it should be understood that the present invention may be embodied in the following forms.

[0031] In the above embodiment, the variable resistor is used to change the rotation speed of the motor 16a. Instead, the variable resistor may be omitted, and the rotation speed of the motor 16a may be fixed when the trigger switch 20 is activated.

[0032] In the above embodiment, among the two contacts 25, the movable contact 25b is pivotal, and the fixed contact 25a is fixed. Instead, the two contacts 25 may both be movable.

[0033] In the above embodiment, the power tool 10 is used as a drill driver. Instead, the power tool 10 may be used as an impact driver, an impact wrench, a hammer drive, a vibration drill, a jigsaw, a sealing gun, or the like.

[0034] The present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein.

Claims

1. A trigger switch (20) including two contacts (25a, 25b) that are used to supply power to a load (16a), an anti-conduction portion (26) arranged between the two contacts when the trigger switch (20) is deactivated,
wherein the anti-conduction portion (26) is moved away from between the two contacts (25a, 25b) when the trigger switch (20) is activated;the trigger switch (20)is **characterized by** further comprising
a trigger (22) adapted to be pulled by a user, wherein the anti-conduction portion (26) is moved away from between the two contacts (25a, 25b) when the trigger (22) is pulled, wherein the anti-conduction portion (26) is moved away from between the two contacts (25a, 25b) in the same direction as the pulling direction of the trigger (22).

2. The trigger switch (20) according to claim 1, further being **characterized by:**

a support (24) that supports the trigger (22); and
a housing (23) that accommodates the support (24) and includes an opening (23a), wherein the support (24) includes a slider (24b) inserted through the opening (23a),
a support body (24a) coupled to the slider (24b), and a compression spring (24c) coupled between the support body (24a) and the housing (23), and
the anti-conduction portion (26) is arranged in the support body (24a).

3. The trigger switch (20) according to claim 2, being **characterized in that:**

the two contacts include a movable contact (25b), pivoted in cooperation with movement of the trigger (22), and a fixed contact (25a) opposed to the movable contact (25b).

4. The trigger switch (20) according to any one of claims 1 to 3, being **characterized in that:**

the trigger switch (20) is activated when the two contacts (25a, 25b) are in contact with each other and deactivated when the two contacts (25a,

25b) are separated from each other.

5. A power tool (10) being **characterized by** comprising:

the trigger switch (20) according to any one of claims 1 to 4.

Patentansprüche

1. Auslöseschalter (20) mit zwei Kontakten (25a, 25b), die verwendet werden, um einer Last (16a) Strom zuzuführen,
einem nicht leitendem Abschnitt (26), der zwischen den zwei Kontakten angeordnet ist, wenn der Auslöseschalter (20) deaktiviert ist,
wobei der nicht leitende Abschnitt (26) von zwischen den zwei Kontakten (25a, 25b) weg bewegt wird, wenn der Auslöseschalter (20) aktiviert wird, wobei der Auslöseschalter (20) **dadurch gekennzeichnet ist, dass** er ferner umfasst:

einen Auslöser (22), der dafür geeignet ist, dass ihn ein Benutzer betätigt, wobei der nicht leitende Abschnitt (26) von zwischen den zwei Kontakten (25a, 25b) weg bewegt wird, wenn der Auslöser (22) betätigt wird, wobei der nicht leitende Abschnitt (26) von zwischen den zwei Kontakten (25a, 25b) in dieselbe Richtung wie die Betätigungsrichtung des Auslösers (22) weg bewegt wird.

2. Auslöseschalter (20) nach Anspruch 1, ferner **gekennzeichnet durch**:

einen Halter (24), der den Auslöser (22) hält, und ein Gehäuse (23), in dem der Halter (24) untergebracht ist, und das eine Öffnung (23a) aufweist, wobei der Halter (24) ein Schiebeelement (24b) aufweist, das **durch** die Öffnung (23a) eingeführt wird,
einen Halterkörper (24a), der mit dem Schiebeelement (24b) gekoppelt ist,
und eine Druckfeder (24c), die zwischen den Halterkörper (24a) und das Gehäuse (23) gekoppelt ist, und
wobei der nicht leitende Abschnitt (26) in dem Halterkörper (24a) angeordnet ist.

3. Auslöseschalter (20) nach Anspruch 2, **dadurch gekennzeichnet, dass**:

die zwei Kontakte einen bewegbaren Kontakt (25b), der im Zusammenwirken mit einer Bewegung des Auslösers (22) geschwenkt wird, und einen festen Kontakt (25a) umfassen, der dem bewegbaren Kontakt (25b) gegenüberliegt.

4. Auslöseschalter (20) nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass**:

der Auslöseschalter (20) aktiviert ist, wenn die zwei Kontakte (25a, 25b) in Kontakt miteinander stehen, und deaktiviert ist, wenn die zwei Kontakte (25a, 25b) voneinander getrennt sind.

5. Elektrowerkzeug (10), **dadurch gekennzeichnet, dass** es umfasst:

den Auslöseschalter (20) nach einem der Ansprüche 1 bis 4.

Revendications

1. Déclencheur (20) comprenant deux contacts (25a, 25b) qui sont utilisés pour fournir l'alimentation à une charge (16a),
une partie anti-conduction (26) agencée entre les deux contacts lorsque le déclencheur (20) est désactivé,
dans lequel la partie anti-conduction (26) est éloignée d'entre les deux contacts (25a, 25b) lorsque le déclencheur (20) est activé ; le déclencheur (20) est **caractérisé en ce qu'**il comprend en outre :

une gâchette (22) adaptée pour être tirée par un utilisateur, dans lequel la partie anti-conduction (26) est éloignée d'entre les deux contacts (25a, 25b) lorsque la gâchette (22) est tirée, dans lequel la partie anti-conduction (26) est éloignée d'entre les deux contacts (25a, 25b) dans la même direction que la direction de traction de la gâchette (22).

2. Déclencheur (20) selon la revendication 1, **caractérisé en outre par** :

un support (24) qui supporte la gâchette (22) ; et un boîtier (23) qui loge le support (24) et comprend une ouverture (23a), dans lequel le support (24) comprend une glissière (24b) insérée à travers l'ouverture (23a),
un corps de support (24a) couplé à la glissière (24b),
et un ressort de compression (24c) couplé entre le corps de support (24a) et le boîtier (23), et
la partie anti-conduction (26) est agencée dans le corps de support (24a).

3. Déclencheur (20) selon la revendication 2, **caractérisé en ce que** :

les deux contacts comprennent un contact mobile (25b) pivoté en coopération avec le mouvement de la gâchette (22) et un contact fixe (25a)

opposé au contact mobile (25b).

4. Déclencheur (20) selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** :

le déclencheur (20) est activé lorsque les deux contacts (25a, 25b) sont en contact entre eux et désactivé lorsque les deux contacts (25a, 25b) sont séparés l'un de l'autre.

5. Outil électrique (10) **caractérisé en ce qu'**il comprend :

le déclencheur (20) selon l'une quelconque des revendications 1 à 4.

Fig.1

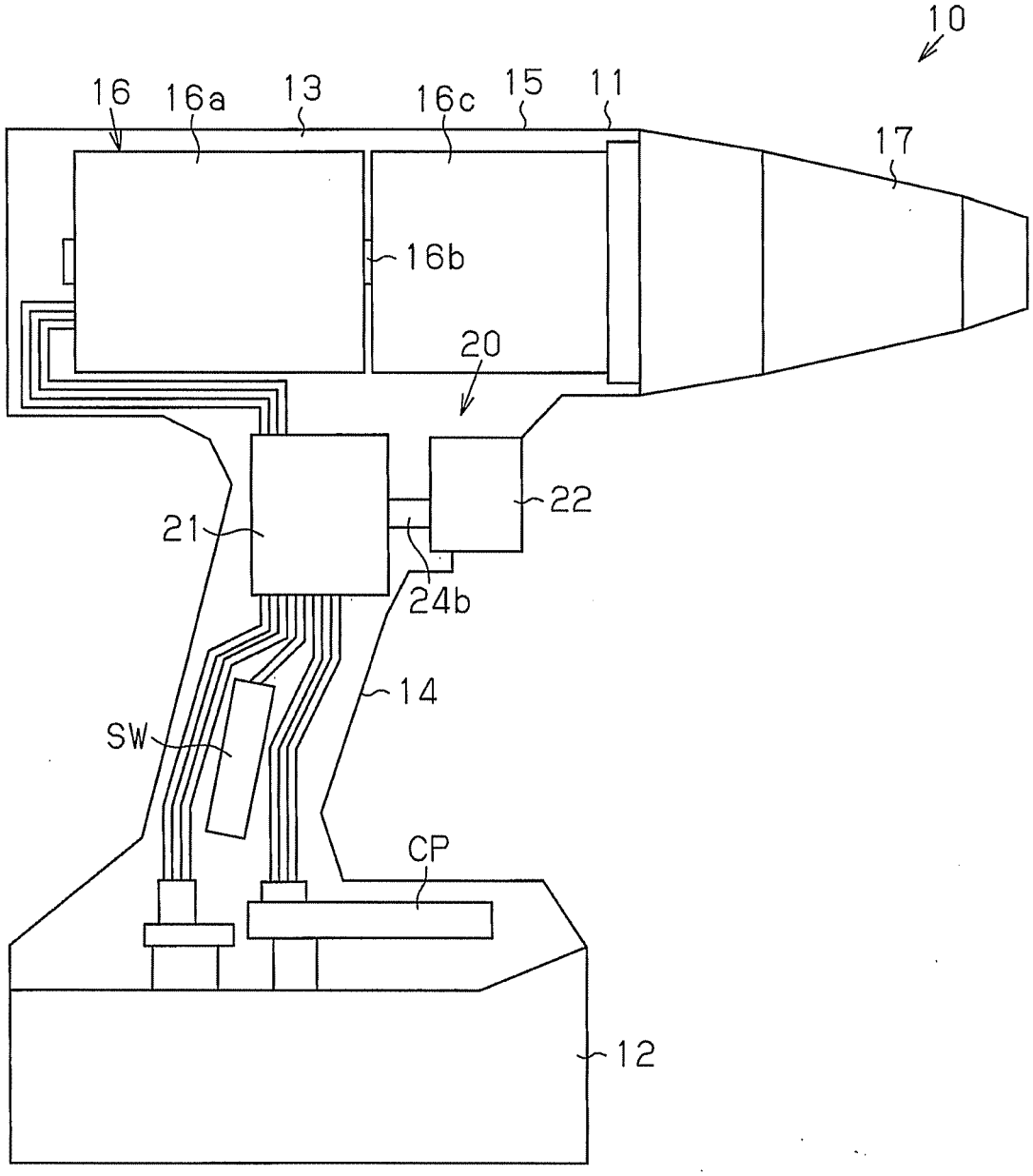


Fig.2

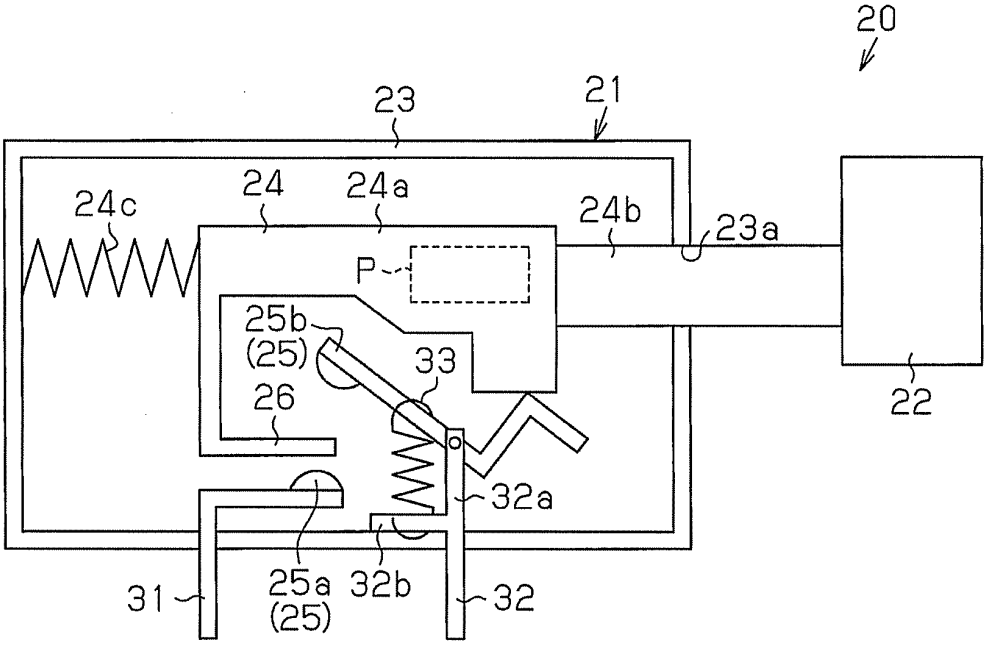
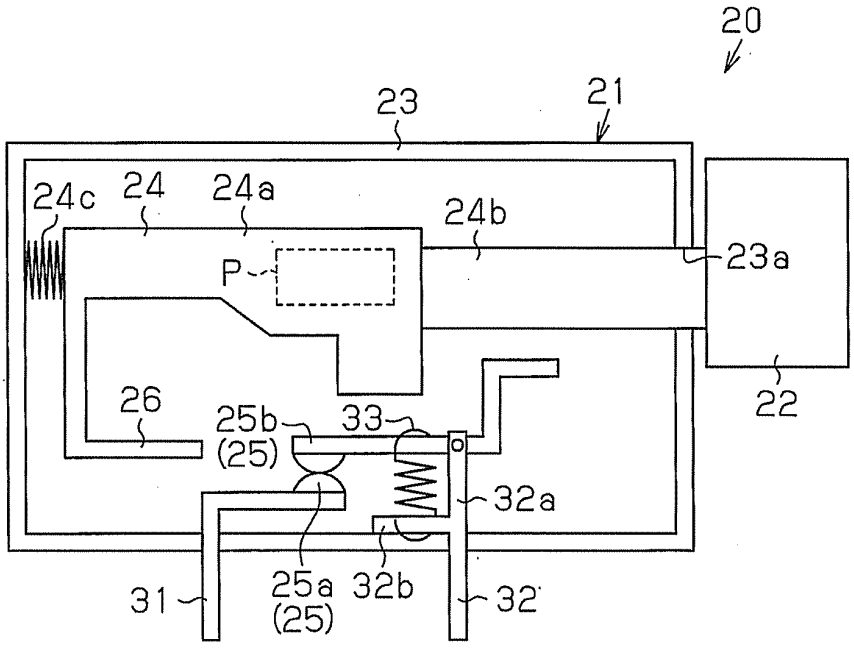

20
23
21
24
24a
24c
24b
23a
P
25b
(25)
33
26
22
32a
31
25a
(25)
32b
32

Fig.3


20
23
21
24c
24
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24b
23a
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32a
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25a
(25)
32b
32

Fig.4

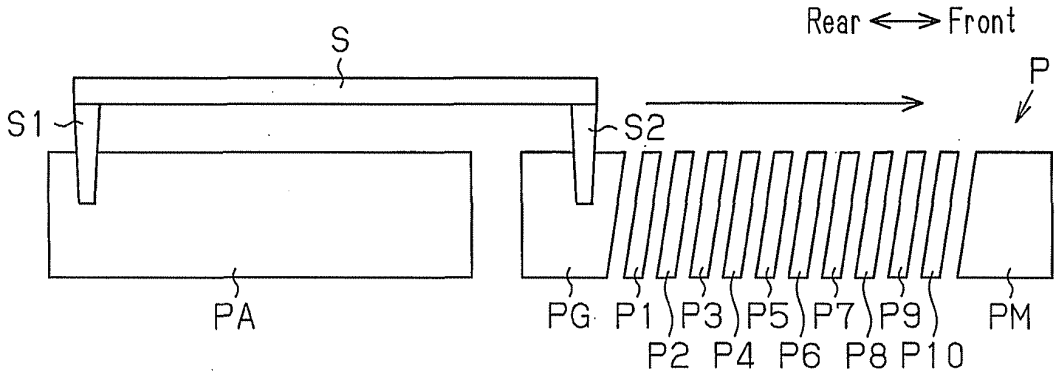


Fig.5

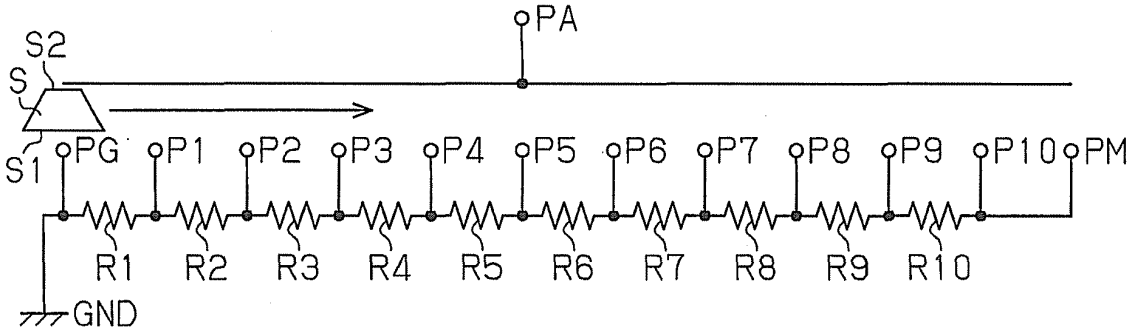
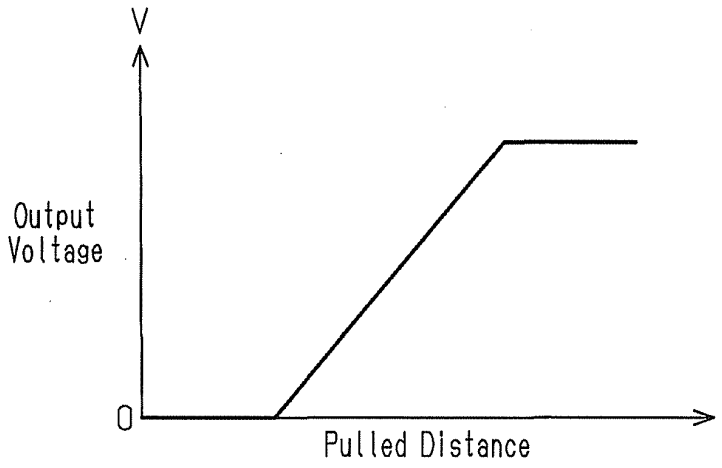


Fig.6



REFERENCES CITED IN THE DESCRIPTION

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