



(11) **EP 3 899 997 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
30.10.2024 Bulletin 2024/44

(51) International Patent Classification (IPC):
H01H 1/16 ^(2006.01) **H01H 1/42** ^(2006.01)
H01H 33/28 ^(2006.01)

(21) Application number: **19831864.4**

(52) Cooperative Patent Classification (CPC):
H01H 1/16; H01H 1/42; H01H 33/285

(22) Date of filing: **23.12.2019**

(86) International application number:
PCT/GB2019/053687

(87) International publication number:
WO 2020/136372 (02.07.2020 Gazette 2020/27)

(54) **AN ELECTRICAL SWITCH AND AN ELECTRICAL SWITCH SYSTEM**
ELEKTRISCHER SCHALTER UND ELEKTRISCHES SCHALTERSYSTEM
COMMUTATEUR ÉLECTRIQUE ET SYSTÈME DE COMMUTATEUR 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: **23.12.2018 GB 201821167**

(43) Date of publication of application:
27.10.2021 Bulletin 2021/43

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DE-U- 6 811 150 FR-A1- 2 891 395

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Description

[0001] The present invention relates to an electrical switch. More particularly, but not exclusively, the present invention relates to an electrical switch comprising first and second arms, the second arm comprising a wheel, the switch being adapted such that as the switch closes an arcing portion of the first arm contacts the wheel before a main portion of the first arm contacts a body portion of the second arm. The present invention also relates to an electrical switch system. More particularly, but not exclusively, the present invention relates to an electrical switch system comprising an electrical switch, one arm of the electrical switch being connected to a power supply, the other arm being connected to a load.

[0002] Electrical switches for use in high current applications are known. Such switches are typically designed to carry currents of up to 10,000 Amps. However, if the switch is closed onto a faulty load the switch could be required to carry a current in the range 100,000 to 150,000 Amps even if only briefly. An example of such an application is in the field of electric railways.

[0003] DE6811150U discloses a coaxial two-way switch with a rotatable contact device which can be moved into at least two switching positions, in particular via a magnetic drive, and which is designed as an insulating disc with strip conductors applied on both sides, with which fork contacts which are connected to the inner conductor of the relevant coaxial conductor section interact.

[0004] FR2891395 discloses a disconnection module for electrical apparatus e.g. circuit-breaker, which has two pairs of mobile contacts coupled by a rotation driving mechanism that is arranged for inverting rotation of one pair with respect to other pair.

[0005] Document EP1961 027 discloses a high voltage circuit breaker having fixed contacts on a carrier and movable contacts that move on shaft. The fixed contacts have a have permanent magnets that operate to extinguish any arcing between the contacts.

[0006] A particular problem associated with switches used in high current applications is the Lorentz force.

[0007] As the arm of the switch approaches an electrical contact to close a circuit pre contact arcing occurs and current starts to flow. The Lorentz force pinches the contact and the switch arm together and considerable force has to be employed to fully insert the switch arm into the contact. Because of this such switches tend to be large as they must include a driving mechanism to provide the necessary force to drive the arm home into the contact. Typically large springs or mechanical or hydraulic rams are employed. Use of such driving mechanisms tends to cause the arm or contact to deform or wear away so reducing the life of the switch. Typically such switches can only be used less than ten times before they need to be replaced at considerable cost.

[0008] A further problem with such known switches is that when pre contact arcing occurs, it always occurs

between the same two points on the switch arm and contact. This erodes the switch arm and contact, further reducing the lifetime of the switch.

[0009] Both of these problems are particularly severe in the case of high current DC switches. This is due to the high rate of increase of the DC current, typically at a rate of around 40kA/ms.

[0010] The current invention seeks to overcome the problems of the prior art.

[0011] Accordingly, the present invention provides a electrical switch according to claim 1.

[0012] Only a relatively small force needs to be used to open and close the switch of the current invention.

[0013] Further, pre contact arcing does not always occur between the same points on the wheel and arcing portion. The switch according to the invention therefore has a considerably longer lifespan than known switches.

[0014] Preferably the main portion comprises at least one pair of spaced apart main portion fingers, the body portion being adapted to be received between the main portion fingers.

[0015] Preferably the electrical switch further comprises at least one electrically conductive contact washer having a central aperture, the contact washer being arranged on a face of the wheel.

[0016] Preferably the wheel is sandwiched between contact washers.

[0017] Preferably the contact washer comprises a plurality of spaced apart first slots extending from the central aperture part way to the outer edge of the washer.

[0018] Preferably the contact washer comprises a plurality of spaced apart second slots extending from the outer edge of the washer part way to the central aperture.

[0019] Preferably the first slots are interdigitated with the second slots.

[0020] In a further aspect of the invention there is provided an electrical switch system comprising

an electrical switch as claimed in any one of claims 1 to 7; and,

a power supply connected to one of the first and second arms.

[0021] Preferably the electrical switch system further comprises a load connected to the other arm.

[0022] Preferably the load is an electric vehicle.

[0023] The present invention will now be described by way of example only and not in any limitative sense with reference to the accompanying drawings in which

Figures 1(a) to 1(d) show a known electrical switch for use in a high current application in schematic form.

Figure 2 shows a first embodiment of an electrical switch according to the invention;

Figure 3 shows the end of the second arm of the switch of figure 1;

Figures 4(a) and 4(b) show the contact washer of the electrical switch of figure 1;

Figure 5 shows the switch of figure 1 in the closed configuration;

Figure 6 shows the second arm of a further embodiment of a switch according to the invention;

Figure 7 shows an example of a switch not falling within the scope of the invention;

Figure 8 shows an embodiment of an electrical switch system according to the invention; and,

Figure 9 shows, in vertical cross section, the second arm of a further embodiment of a switch according to the invention.

[0024] Shown in figure 1(a) in schematic form is a known switch 1 for use in a high current application. The switch 1 comprises a first electrically conductive arm 2 connected to a voltage source 3. It further comprises a second electrically conductive arm 4 connected to a load 5, which in this application is an electric train. The second arm 4 ends in a connector 6 which comprises first and second spaced apart fingers 7,8. In figure 1(a) the two arms 2,4 are spaced apart and the switch 1 is in the open configuration.

[0025] In order to switch the switch 1 to the closed configuration the first arm 2 is moved towards the second arm 4 as shown in figure 1(b). As the first arm 2 approaches the second arm 4 pre contact arcing occurs as shown and current starts to flow from the first arm 2 to the second arm 4.

[0026] As the first arm 2 is moved further it is received between the spaced apart fingers 7,8. At this point the current flowing from the first arm 2 and then through the fingers 7,8 causes the fingers 7,8 to be urged towards the first arm 2, so gripping the first arm 2, due to the Lorentz force. This is shown in figure 1(c).

[0027] This gripping of the first arm 2 by the fingers 7,8 produces significant friction between the first arm 2 and fingers 7,8. In order to push the first arm 2 fully home between the fingers 7,8 considerable force must be used. A spring 9 or other hydraulic or mechanical means is typically used to achieve this, as shown in figure 1(d).

[0028] Shown in figure 2 in perspective view is a first embodiment of an electrical switch 10 according to the invention. The switch comprises a first electrically conductive arm 11 which comprises an electrically conductive arcing portion 12 and an electrically conductive main portion 13. The arcing portion 12 comprises first and second spaced apart arcing fingers 14 pivotally connected to a base portion 15 by an arcing finger pivot 16. The

main portion 13 comprises a plurality of pairs of main portion fingers 17, each pair of main portion fingers 17 being pivotally connected to the base portion 15 by a base portion pivot 18. The base portion 15 is shown connected to a load 19 which is in turn connected to earth 20.

[0029] The electrical switch 10 further comprises a second electrically conductive arm 21. The second electrically conductive arm 21 comprises an electrically conductive body portion 22. The second arm 21 further comprises an electrically conductive wheel 23 which is connected to the body portion 22 by a wheel axle 24 which extends along a wheel axis. The wheel 23 is free to rotate about the wheel axis.

[0030] The end of the second arm 21 proximate to the first arm 11 is shown in greater detail in figure 3. As can be seen from this figure the body portion 22 comprises a plurality of electrically conductive receiving fingers 25. Each receiving finger 25 terminates in an electrically taper 26. The taper 26 may be electrically insulating. The electrically conductive wheel 23 is sandwiched between contact washers 27. The contact washers 27 abut the body portion 22 ensuring a good electrical contact between the wheel 23 and the body portion 22. In an alternative embodiment (not shown) the contact washer 27 is cylindrical and arranged around the wheel axle 24. The wheel 23 is arranged around the contact washer 27.

[0031] An example of a contact washer 27 is shown in plan view and side view in figures 4(a) and 4(b). The contact washer 27 comprises an electrically conductive, preferably copper, disk defined by an outer edge 28. Extending through the center of the disk is a central aperture 29. A plurality of spaced apart first slots 30 extend from the central aperture 29 part way to the outer edge 28. A plurality of spaced apart second slots 31 extend from the outer edge 28 part way to the central aperture 29. The first slots 30 and second slots 31 are interdigitated. As can be seen in side view, the center of the washer 27 is slightly raised with respect to the outer edge 28 so that the washer 27 is slightly bowl shaped and matches the profile of the wheel 23.

[0032] Returning to figure 3, each contact washer 27 is centered on a face of the wheel 23 with the center of the central aperture 29 coaxial with the wheel axle 24.

[0033] Returning to figure 2, the switch 10 is shown in the open configuration with the first and second arms 11,21 spaced apart. The switch 10 further comprises a pivot mechanism 32 connected to each of the pairs of arcing fingers 14 and main portion fingers 17. In order to switch the switch 10 from the open configuration to a closed configuration the pivot mechanism 32 simultaneously pivots the pair of arcing fingers 14 and multiple pairs of main portion fingers 17 towards the second electrically conductive arm 21. As the arcing fingers 14 approach the wheel 23 pre-contact arcing occurs between the arcing fingers 14 and wheel 23. As pivoting continues the edge of the wheel 23 is received between the arcing fingers 14. Current flows from the arcing fingers 14 through the wheel 23 and contact washers 27 to the body

portion 22 of the second arm 21. This current flow causes the arcing fingers 14 to grip the wheel 23 firmly. As pivoting continues further the wheel 23 rotates around the wheel axis, so allowing pivoting to continue with little resistance.

[0034] As pivoting continues further each pair of main portion fingers 17 slides onto a taper 26 and then onto a receiving finger 25. A significant portion of the current is flowing through the arcing fingers 14 and wheel 23. The remainder of the current is divided between each of the pairs of main portion fingers 17. The current flowing through a single pair of main portion fingers 17 to its associated receiving finger 25 is therefore relatively small and so the Lorentz force between the main portion fingers 17 and the receiving finger 25 is also small. The pivot mechanism 32 can therefore pull the main portion fingers 17 onto the receiving fingers 25 with relatively little force, so closing the switch 10.

[0035] The switch 10 is designed such that the main portion fingers 17 slide onto the receiving fingers 25 shortly after the arcing fingers 14 engage the wheel 23. Typically the time difference is of the order a few milliseconds so as to avoid overheating the arcing fingers 14 and contact washers 27.

[0036] The switch 10 according to the invention can therefore be switched from the open configuration to the closed configuration (and vice versa) with relatively little force. The switch 10 is shown in the closed configuration in figure 5. A further advantage of the switch 10 according to the invention is that the wheel 23 is not necessarily in the same orientation with respect to the remainder of the second arm 21 each time the switch 10 is opened or closed. The erosion of the wheel 23 caused by pre contact arcing is therefore spread around the periphery of the wheel 23 rather than concentrated at one spot.

[0037] Shown in figure 6 is the end of the second arm 21 of an alternative embodiment of the invention. In this embodiment the body portion 22 comprises a plurality of pairs of receiving fingers 25. The main portion 13 of the first arm 11 comprises a plurality of single main portion fingers 17 each pivotally connected to the base portion 15. The operation of this second embodiment is similar to that of the first embodiment only with the main portion fingers 17 being received between pairs of receiving fingers 25 rather than vice versa.

[0038] Shown in figure 7 is an example of an electrical switch 10 not falling within the scope of the invention. The electrical switch 10 comprises a first electrically conductive arm 11. The first arm 11 comprises an electrically conductive arcing portion 12 and an electrically conductive main portion 13. The arcing portion 12 comprises a resiliently deformable rail 33 having a slot 34 running along its length. The rail 33 is connected to a base portion 15. The main portion 13 comprises a plurality of main portion fingers 17 fixedly extending from the base portion 15.

[0039] The switch 10 further comprises a second electrically conductive arm 21. The second arm 21 comprises

a body portion 22. Connected to the body portion 22 by a wheel axle 24 which extends along a wheel axis is an electrically conductive wheel 23. The wheel 23 is free to rotate about the wheel axle 24. The body portion 22 comprises a plurality of receiving fingers 25 extending towards the first electrically conductive arm 11.

[0040] The switch 10 further comprises a displacement mechanism 35 connected to the first arm 11. The displacement mechanism 35 is adapted to linearly displace the first arm 11 towards and away from the second arm 21.

[0041] The switch 10 is shown in the open configuration with the first and second arms 11,21 spaced apart. In order to switch the switch 10 to the closed configuration the displacement mechanism 35 displaces the first arm 11 towards the second arm 21 until the wheel 23 engages the slot 34 running along the length of the rail 33. As the first arm 11 is displaced further the wheel 23 rotates and the rail 33 is deformed until the receiving fingers 25 are received between the main portion fingers 17, so closing the switch 10. As before, the switch 10 can be switched between open and closed configurations with relatively little force so making the switch 10 reliable and inexpensive to manufacture.

[0042] Shown in figure 8 is an electrical switch system 40 according to the invention. The electrical switch system 40 comprises an electrical switch 10 as previously described. Connected to one arm 11,21 is a power supply 41. The power supply 41 can provide a high current, typically in the range 50,000 to 200,000 Amps, more preferably in the range 80,000 - 150,000 Amps. More preferably the current is in the range 100,000 to 140,000 Amps. The other arm 11,21 of the switch 10 is connected to a load 42 which is in turn connected to earth 43. The load 42 is typically an electrically powered vehicle such as a train but the invention is not so limited.

[0043] In the embodiment of figure 2 the switch 10 comprises a plurality of pairs of main portion fingers 17. In an alternative embodiment the switch 10 comprises a single pair of main portion fingers 17.

[0044] The switch 10 can be employed in both AC and DC systems.

[0045] Shown in figure 9 in vertical cross section is a second arm 21 of a further embodiment of an electrical switch 10 according to the invention. The electrically conductive wheel 23 is arranged on a wheel axle 24 which in turn is connected to the body portion 22. The wheel 23 has a recess 36 in each face proximate to the wheel axle 24. The electrical switch 10 further comprises a pair of electrically conductive axle collars 37 arranged around the wheel axle 24. In this embodiment the contact washers 27 are initially flat. As the wheel 23, wheel axle 24 and axle collars 37 are assembled the axle collars 37 deform the contact washers 27 into the desired shape.

Claims

1. A electrical switch (10) comprising a first electrically conductive arm (11) comprising a first electrically conductive arcing portion (12) and an electrically conductive main portion (13); a second electrically conductive arm (21) comprising an electrically conductive body portion (22)

at least one of the first and second arms (11, 21) being adapted to be displaced relative to the other to move the switch (10) between an open configuration in which the first and second arms (11, 21) are spaced apart and a closed configuration in which the main portion (13) is in contact with the body portion (22);

the electrical switch (10) further comprising a pivot mechanism (32) to pivot the arcing portion (12) and the main portion (13) into contact with the body portion (22)

characterised in that

the second electrically conductive arm (21) further comprises an electrically conductive wheel (23) connected to the body portion (22) by a wheel axle (24) which extends along a wheel axis, the wheel (23) being free to rotate about the wheel axis, the wheel (23) being in electrical contact with the body portion (22), wherein in the closed configuration the arcing portion (12) is in contact with the wheel (23), the switch (10) being adapted such that as the switch (10) is switched from the open configuration to the closed configuration the arcing portion (12) contacts the wheel (23) before the main portion (13) contacts the body portion (22); wherein the arcing portion (12) comprises at least one pair of spaced apart arcing fingers (14), the wheel (23) being adapted to be received between the fingers (14), and **in that** the pivot mechanism (32) is adapted to pivot the arcing portion (21) into contact with the wheel (23).
2. An electrical switch (10) as claimed in claim 1, wherein the main portion (13) comprises at least one pair of spaced apart main portion fingers (17), the body portion (22) being adapted to be received between the main portion fingers (17).
3. An electrical switch (10) as claimed in either of claims 1 or 2, further comprising at least one electrically conductive contact washer (27) having a central aperture (29), the contact washer (27) being arranged on a face of the wheel (23).
4. An electrical switch (10) as claimed in claim 3, wherein the wheel (23) is sandwiched between contact washers (27).

5. An electrical switch (10) as claimed in either of claims 3 or 4, wherein the contact washer (27) comprises a plurality of spaced apart first slots (30) extending from the central aperture (29) part way to the outer edge (28) of the washer (27).
6. An electrical switch (10) as claimed in any one of claims 3 to 5, wherein the contact washer (27) comprises a plurality of spaced apart second slots (31) extending from the outer edge (28) of the washer (27) part way to the central aperture (29).
7. An electrical switch (10) as claimed in claim 6 when dependent on claim 5, wherein the first slots (30) are interdigitated with the second slots (31).
8. An electrical switch system (40) comprising

an electrical switch (10) as claimed in any one of claims 1 to 7; and,

a power supply (41) connected to one of the first and second arms (11, 21).
9. An electrical switch system (40) as claimed in claim 8 further comprising a load (19, 42) connected to the other arm (21, 11).
10. An electrical switch system (40) as claimed in claim 9, wherein the load (19) is an electric vehicle.

Patentansprüche

1. Ein elektrischer Schalter (10) mit einem ersten elektrisch leitenden Arm (11), der einen ersten elektrisch leitenden Lichtbogenbildungsteil (12) und einen elektrisch leitenden Hauptteil (13) umfasst; ferner mit einem zweiten elektrisch leitenden Arm (21), der einen elektrisch leitenden Schalterkörper (22) umfasst,

wobei mindestens einer der ersten und zweiten Arme (11, 21) so ausgelegt ist, dass er relativ zu dem anderen Arm verschoben werden kann, um den Schalter (10) zwischen einer offenen Konfiguration (Schalterstellung), in der die ersten und zweiten Arme (11, 21) in einem bestimmten Abstand zueinander angeordnet sind, und einer geschlossenen Konfiguration, in der der Hauptteil (13) in Kontakt mit dem Schalterkörper (22) steht, zu bewegen;

wobei der elektrische Schalter (10) ferner einen Schwenkmechanismus (32) umfasst, mit dem der Lichtbogenbildungsteil (12) und der Hauptteil (13) so geschwenkt werden können, dass der Kontakt mit dem Schalterkörper (22) hergestellt wird,

dadurch gekennzeichnet, dass

- der zweite elektrisch leitende Arm (21) ferner ein elektrisch leitendes Rad (23) umfasst, das mit dem Schalterkörper (22) durch eine Radachse (24) verbunden ist, die entlang einer Raddrehachse angeordnet ist, wobei sich das Rad (23) frei um die Raddrehachse drehen kann, und wobei das Rad (23) in elektrischem Kontakt mit dem Schalterkörper (22) steht, wobei in der geschlossenen Konfiguration der Lichtbogenbildungsteil (12) in Kontakt mit dem Rad (23) steht, und wobei der Schalter (10) so ausgelegt ist, dass, wenn der Schalter (10) von der offenen Konfiguration in die geschlossene Konfiguration umgeschaltet wird, der Lichtbogenbildungsteil (12) in Kontakt mit dem Rad (23) kommt, bevor der Hauptteil (13) in Kontakt mit dem Schalterkörper (22) kommt; dabei weist der Lichtbogenbildungsteil (12) mindestens ein Paar in einem bestimmten Abstand zueinander angeordnete Lichtbogenbildungsfinger (14) auf, wobei das Rad (23) so ausgelegt ist, dass es zwischen den Fingern (14) aufgenommen werden kann, und wobei der Schwenkmechanismus (32) so ausgelegt ist, dass er den Lichtbogenbildungsteil (21) in einer Schwenkbewegung in Kontakt mit dem Rad (23) bringen kann.
2. Elektrischer Schalter (10) nach Anspruch 1, wobei der Hauptteil (13) mindestens ein Paar in einem bestimmten Abstand zueinander angeordnete Hauptteilinger (17) umfasst, und wobei der Schalterkörper (22) so ausgelegt ist, dass er zwischen den Hauptteilingern (17) aufgenommen werden kann.
 3. Elektrischer Schalter (10) nach einem der Ansprüche 1 oder 2, welcher ferner mindestens eine elektrisch leitende Kontaktscheibe (27) mit einer zentralen Öffnung (29) umfasst, wobei die Kontaktscheibe (27) auf einer Stirnfläche des Rades (23) angeordnet ist.
 4. Elektrischer Schalter (10) nach Anspruch 3, wobei das Rad (23) sandwichartig zwischen Kontaktscheiben (27) angeordnet ist.
 5. Elektrischer Schalter (10) nach einem der Ansprüche 3 oder 4, wobei die Kontaktscheibe (27) eine Vielzahl von in einem bestimmten Abstand zueinander angeordneten ersten Schlitzen (30) aufweist, die sich von der zentralen Öffnung (29) über einen Teil der Distanz bis zum Außenrand (28) der Scheibe (27) erstrecken.
 6. Elektrischer Schalter (10) nach einem der Ansprüche 3 bis 5, wobei die Kontaktscheibe (27) eine Vielzahl von in einem bestimmten Abstand zueinander angeordneten zweiten Schlitzen (31) aufweist, die sich vom Außenrand (28) der Scheibe (27) über einen Teil der Distanz bis zur zentralen Öffnung (29) erstrecken.
 7. Elektrischer Schalter (10) nach Anspruch 6 in Abhängigkeit von Anspruch 5, wobei die ersten Schlitze (30) und die zweiten Schlitze (31) ineinandergreifen.
 8. Elektroschaltersystem (40) mit einem elektrischen Schalter (10) nach einem der Ansprüche 1 bis 7; und einer Stromversorgung (41), die mit einem der ersten und zweiten Arme (11, 21) verbunden ist.
 9. Elektroschaltersystem (40) nach Anspruch 8, das ferner einen Verbraucher (19, 42) aufweist, der mit dem anderen Arm (21, 11) verbunden ist.
 10. Elektroschaltersystem (40) nach Anspruch 9, wobei es sich bei dem Verbraucher (19) um ein Elektrofahrzeug handelt.
- ### Revendications
1. Commutateur électrique (10) comprenant un premier bras à conduction électrique (11) comprenant :
 - une première partie à conduction électrique en forme d'arc (12) et une partie principale à conduction électrique (13) ;
 - un deuxième bras à conduction électrique (21) comprenant une partie formant corps à conduction électrique (22) ;
 - au moins l'un parmi le premier bras et le deuxième bras (11, 21) étant configuré pour un déplacement par rapport à l'autre afin de faire déplacer le commutateur (10) entre une configuration ouverte, dans laquelle les premier et deuxième bras (11, 21) sont espacés l'un de l'autre, et une configuration fermée, dans laquelle la partie principale (13) est au contact de la partie principale (22) ;
 - le commutateur électrique (10) comprenant en outre un mécanisme à pivot (32) pour faire pivoter la partie en forme d'arc (12) et la partie principale (13) au contact de la partie formant corps (22),
- caractérisé en ce que :**
- le deuxième bras à conduction électrique (21) comprend en outre une roue à conduction électrique (23) connectée à la partie formant corps (22) par un essieu de roue (24), qui s'étend le long d'un axe de roue, la roue (23) étant libre de tourner autour de l'axe de la roue, la roue (23) se trouvant en contact électrique avec la partie

formant corps (22), selon lequel, dans la configuration fermée la partie en forme d'arc (12) est en contact avec la roue (23), le commutateur (10) étant configuré de sorte que pendant la commutation du commutateur (10) de la configuration ouverte à la configuration fermée, la partie en forme d'arc (12) vient au contact de la roue (23) avant que la partie principale (13) ne vienne au contact de la partie formant corps (22) ;

selon lequel la partie en forme d'arc (12) comprend au moins une paire de doigts d'arc espacés l'un de l'autre (14), la roue (23) étant configuré pour être reçue entre les doigts (14), et **en ce que** le mécanisme de pivot (32) est configuré pour faire pivoter la partie en forme d'arc (21) pour venir au contact de la roue (23).

2. Commutateur électrique (10) selon la revendication 1, selon lequel la partie principale (13) comprend au moins une paire de doigts de partie principale espacés l'un de l'autre (17), la partie formant corps (22) étant configuré pour être reçue entre les doigts de la partie principale (17). 20
3. Commutateur électrique (10) selon l'une quelconque des revendications 1 ou 2, comprenant au moins une rondelle de contact à conduction électrique (27) présentant une ouverture centrale (29), la rondelle de contact (27) étant disposée sur une face de la roue (23). 25
4. Commutateur électrique (10) selon la revendication 3, selon lequel la roue (23) est prise en sandwich entre des rondelles de contact (27). 30
5. Commutateur électrique (10) selon la revendication 3 ou la revendication 4, selon lequel la rondelle de contact (27) comprend une pluralité de premières fentes espacées les unes des autres (30) s'étendant depuis l'ouverture centrale (29) partiellement en direction du bord extérieur (28) de la rondelle (27). 35
6. Commutateur électrique (10) selon l'une quelconque des revendications 3 à 5, selon lequel la rondelle de contact (27) comprend une pluralité de deuxièmes fentes espacées les unes des autres (31) s'étendant depuis le bord extérieur (28) de la rondelle (27) partiellement en direction de l'ouverture centrale (29). 40
7. Commutateur électrique (10) selon la revendication 6 lorsqu'elle dépend de la revendication 5, selon lequel les premières fentes (30) s'intercalent avec les deuxièmes fentes (31). 45
8. Système de commutateur électrique (40) comprenant : 50

un commutateur électrique (10) selon l'une quelconque des revendications 1 à 7 ; et,
une alimentation électrique (41) connectée à l'un parmi les premier et deuxième bras (11, 21).

9. Système de commutateur électrique (40) selon la revendication 8, comprenant en outre une charge (19, 42) connectée à l'autre bras (21, 11). 5
10. Système de commutateur électrique (40) selon la revendication 9, selon lequel la charge (19) est un véhicule électrique. 10

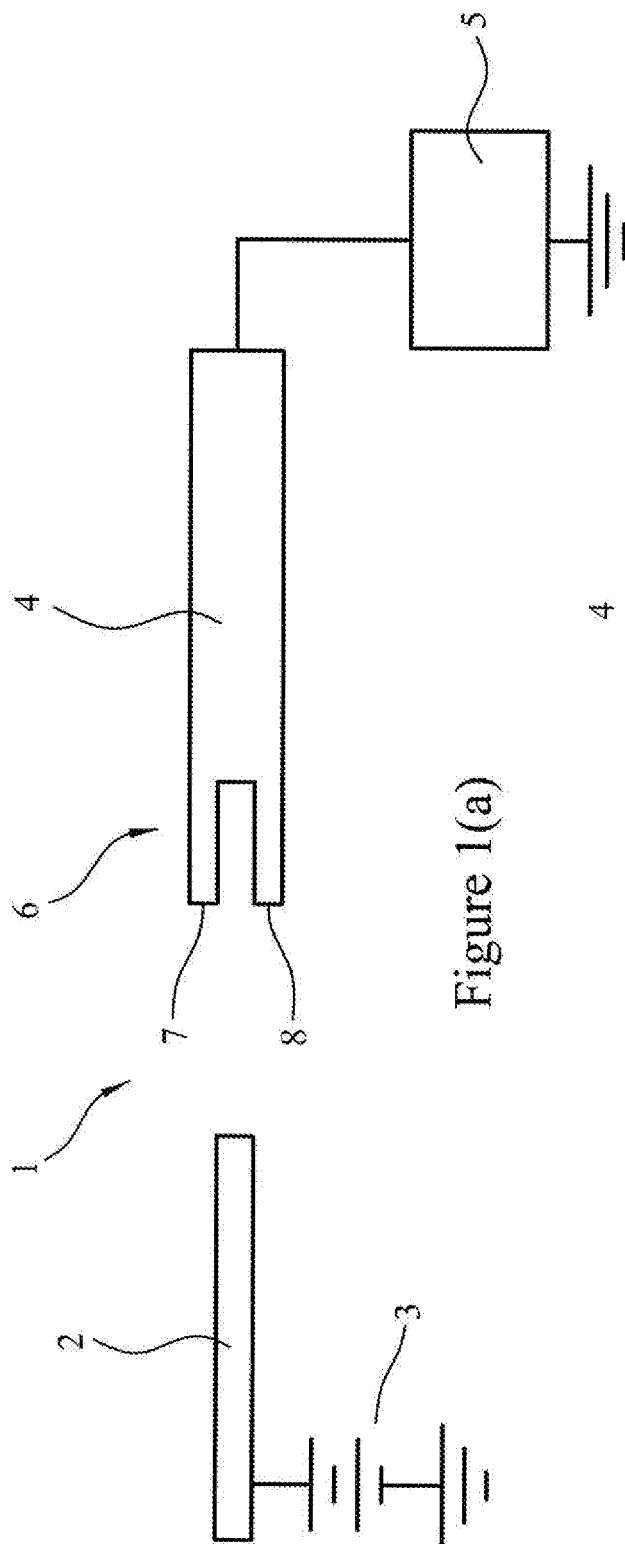


Figure 1(a)

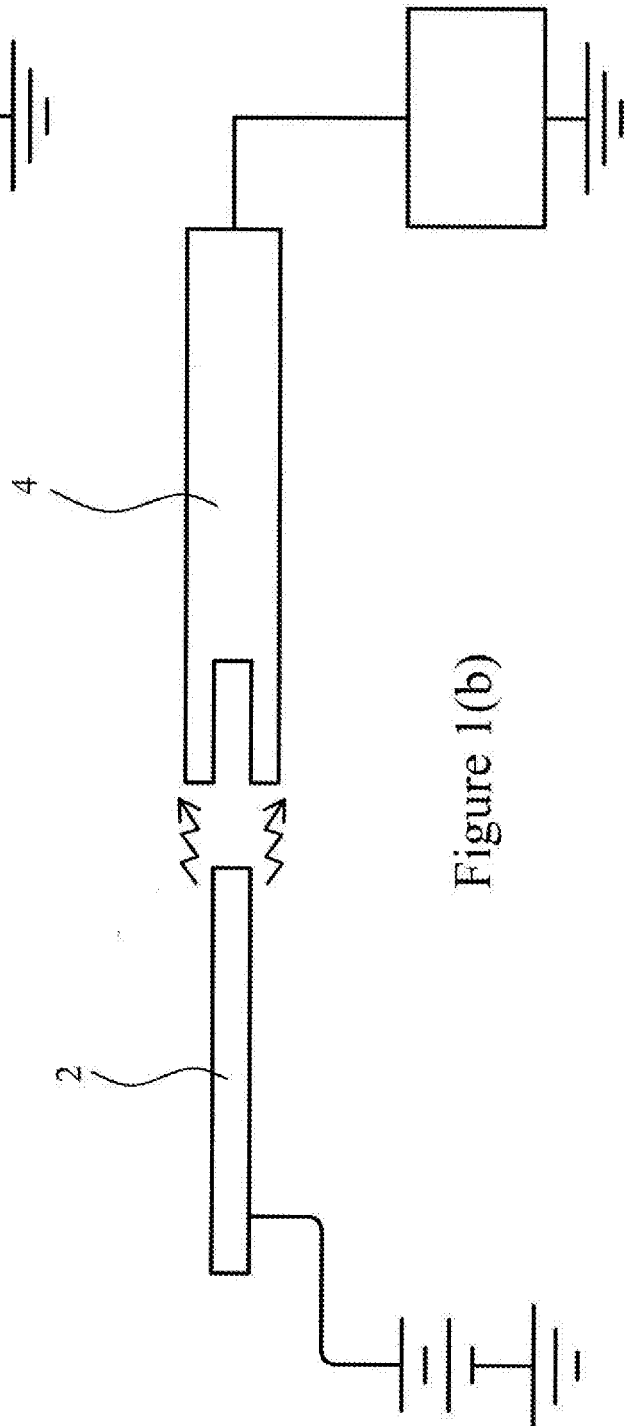


Figure 1(b)

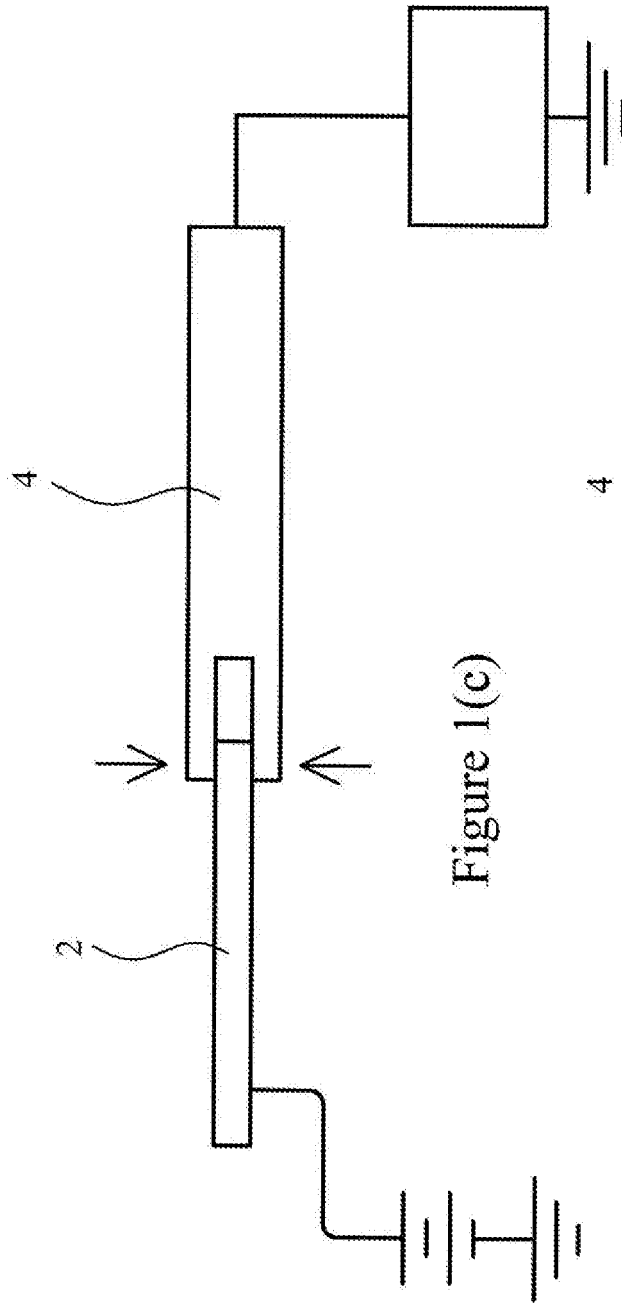


Figure 1(c)

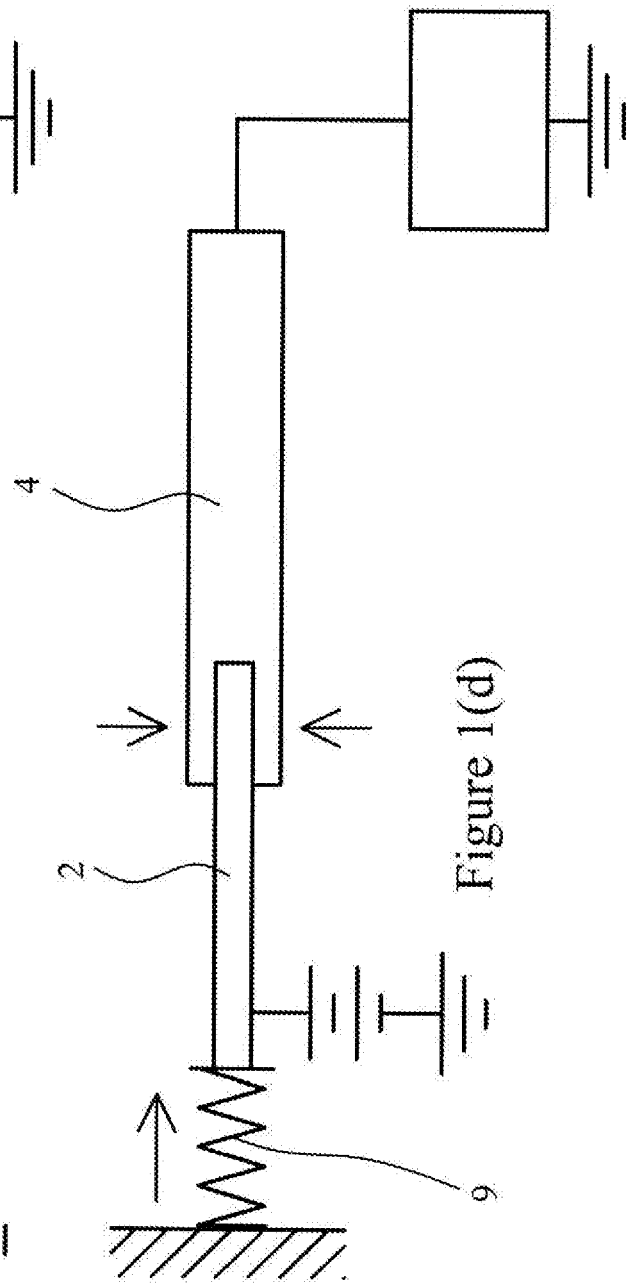


Figure 1(d)

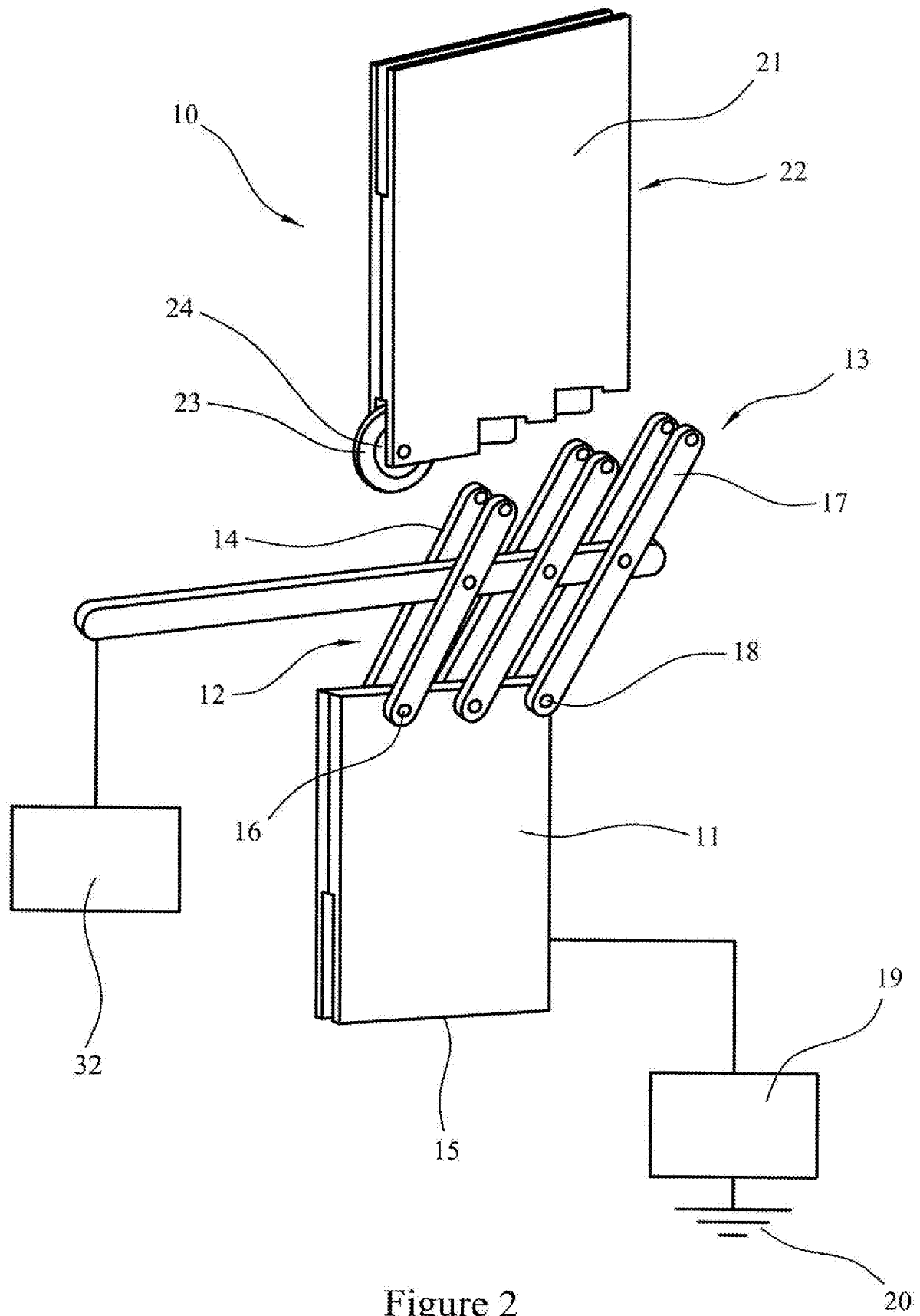


Figure 2

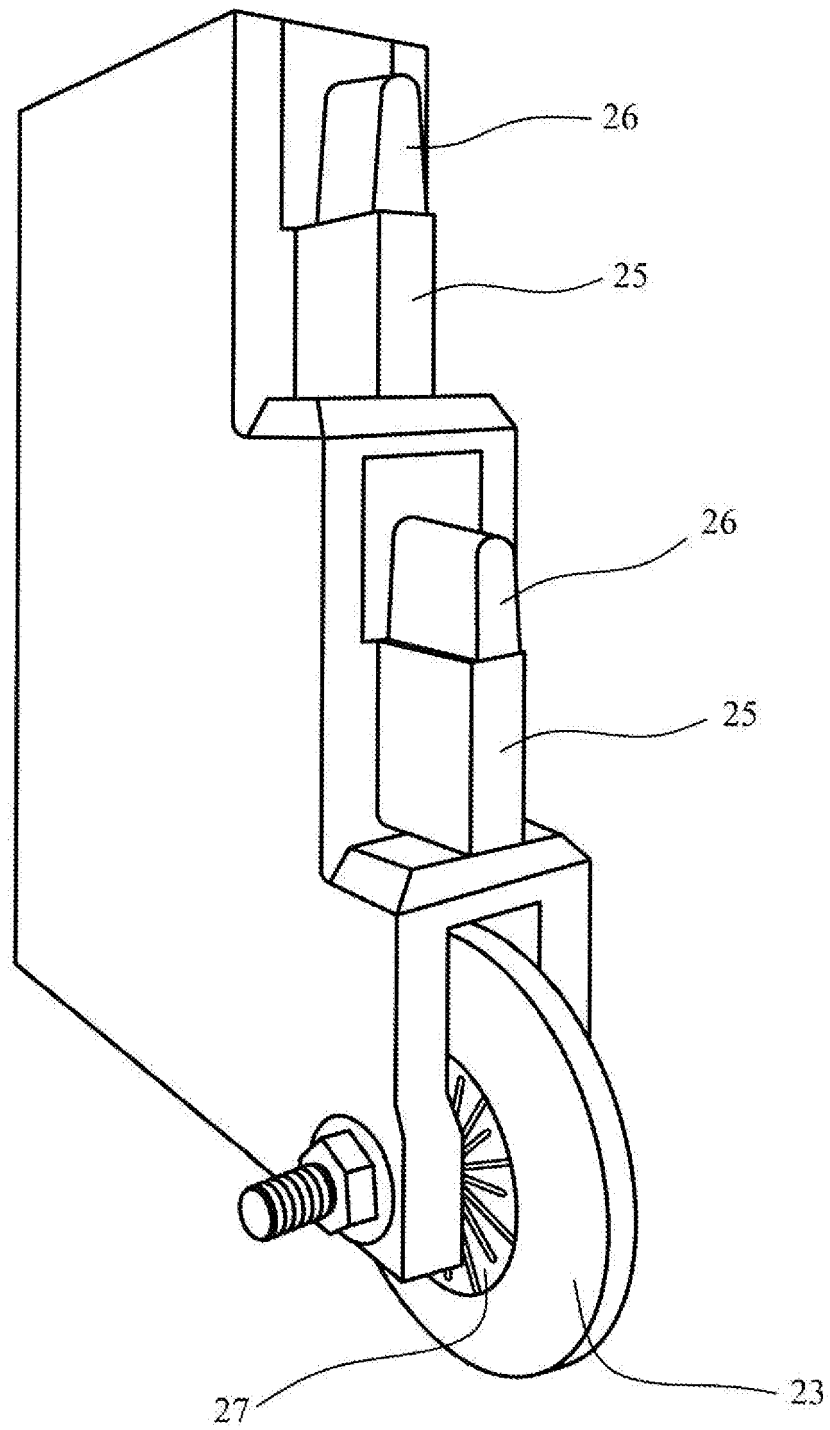


Figure 3

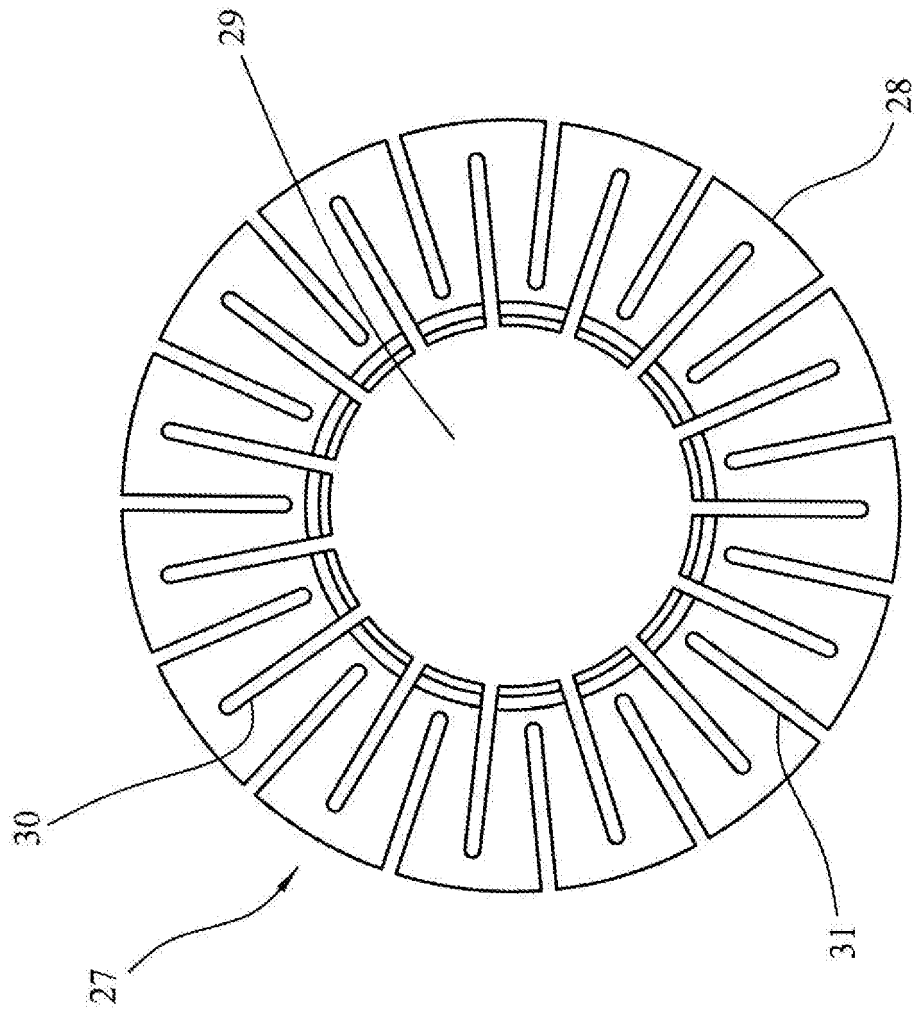


Figure 4(a)

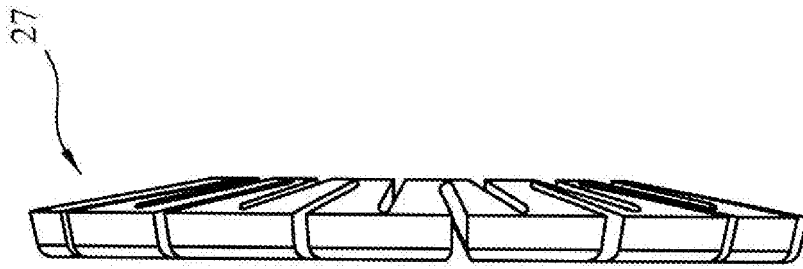


Figure 4(b)

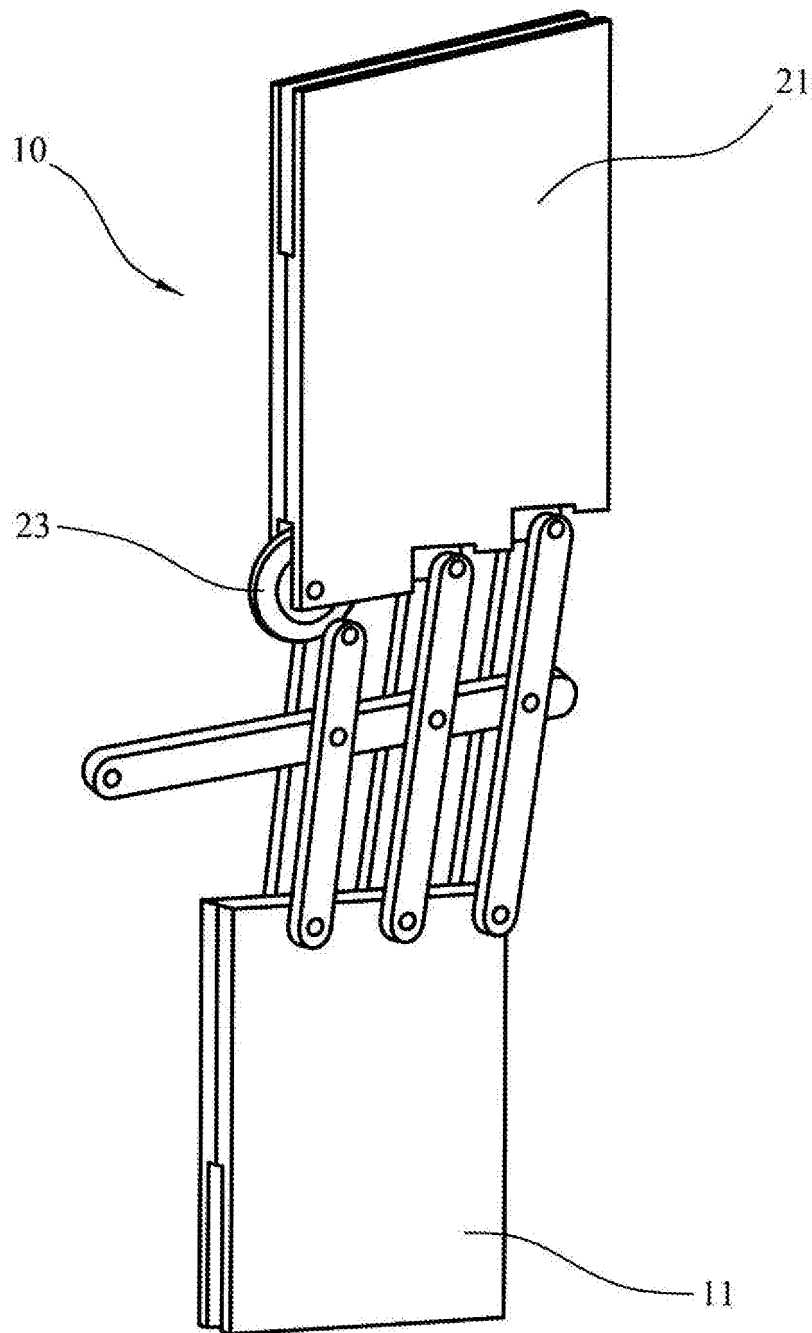


Figure 5

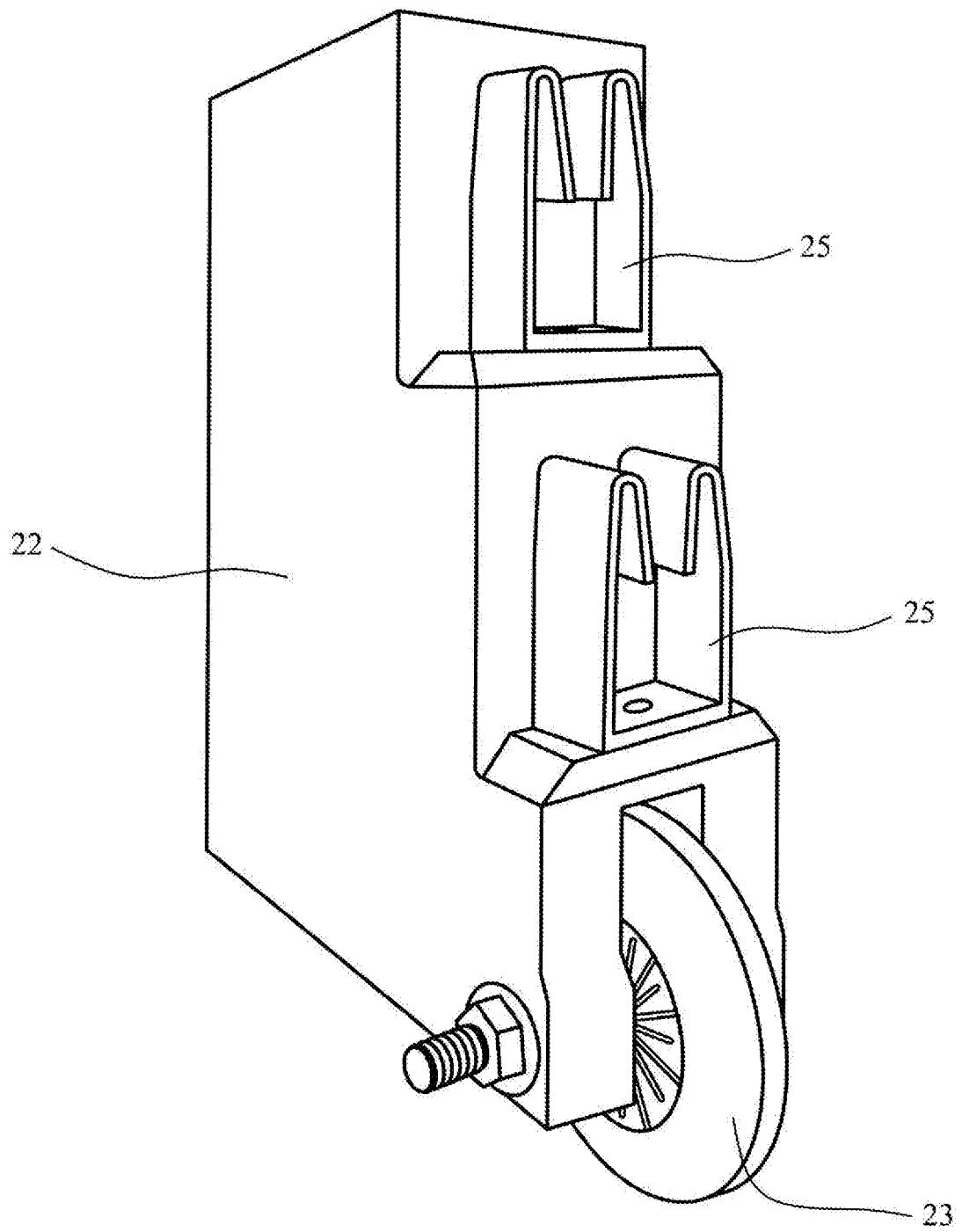


Figure 6

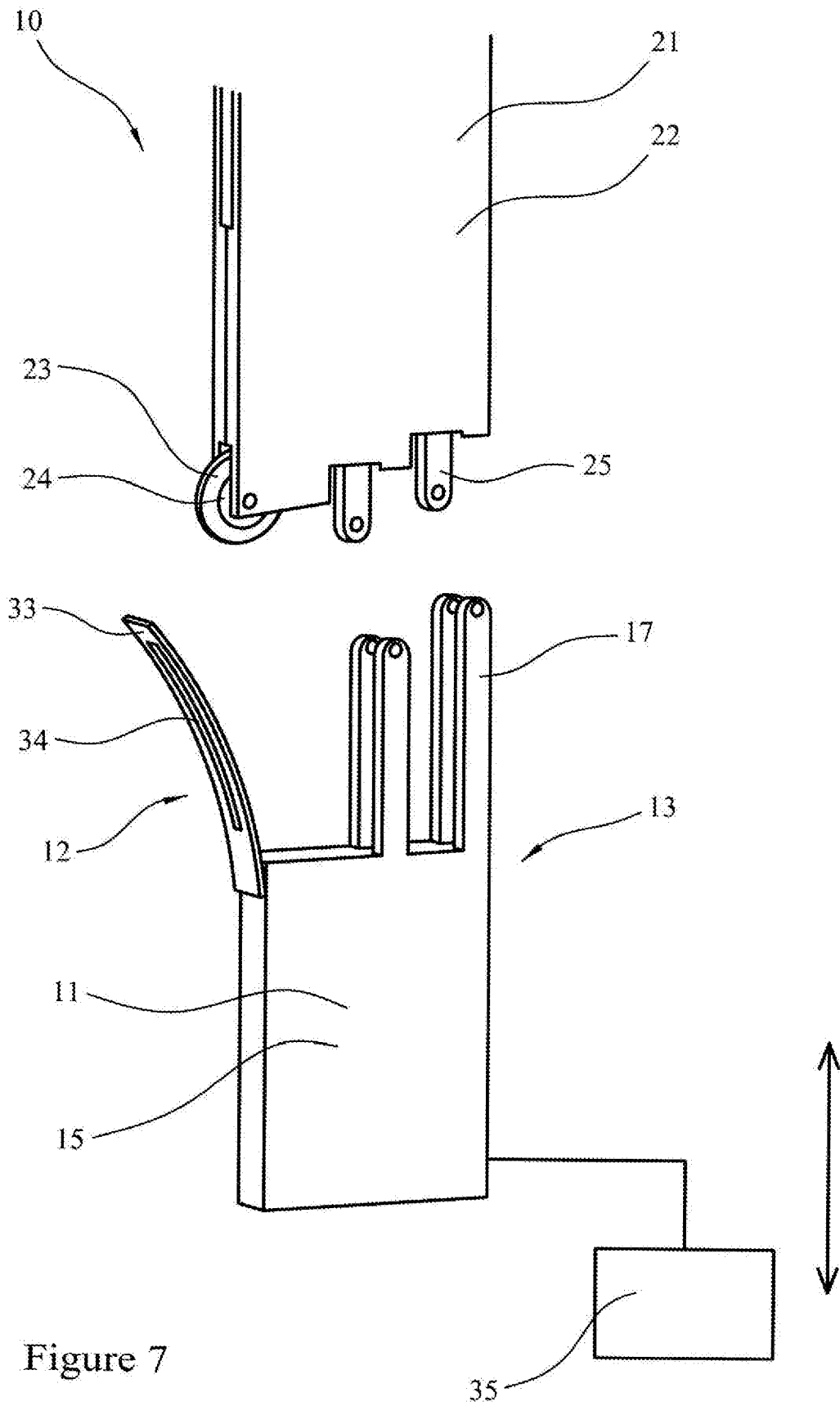


Figure 7

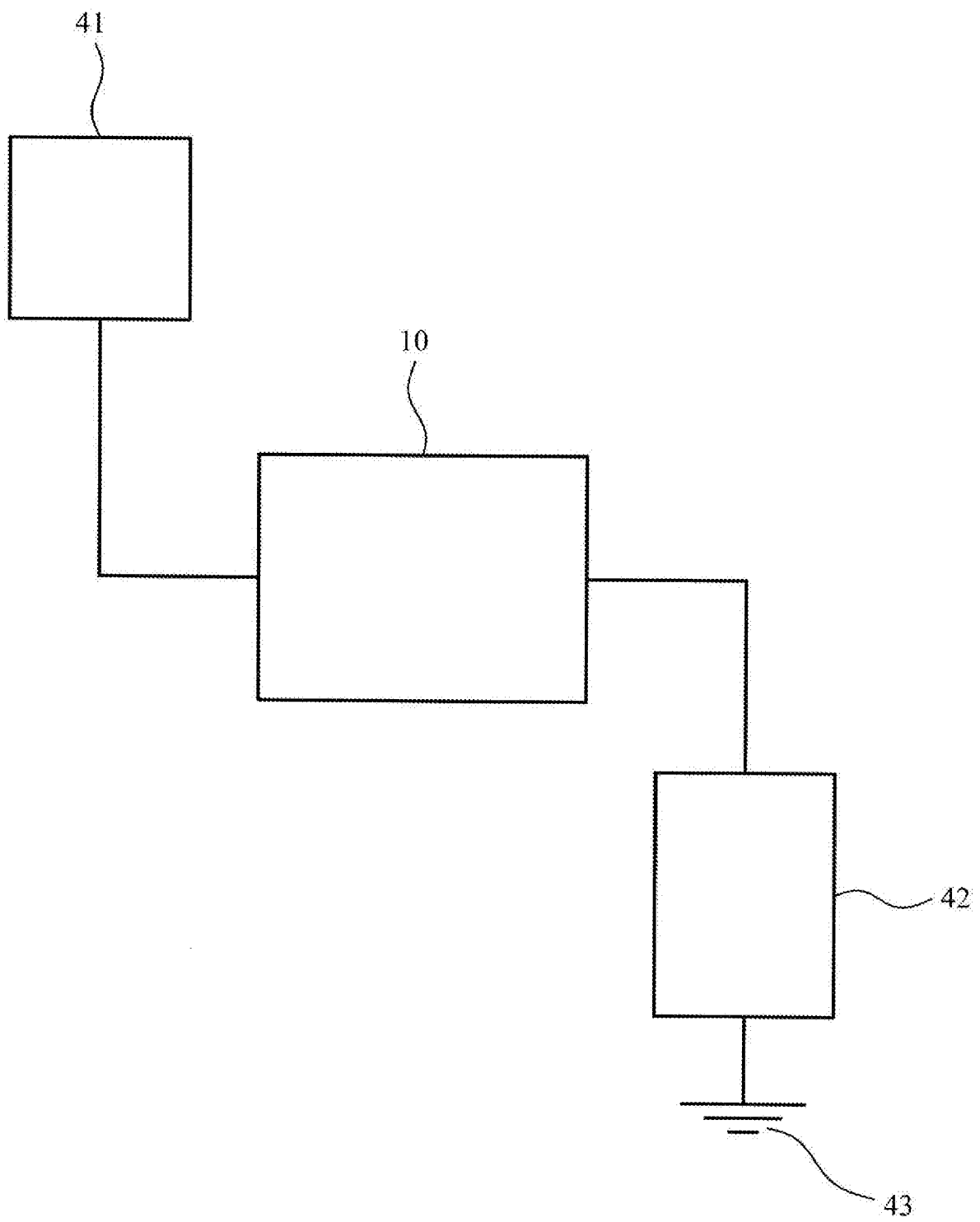


Figure 8

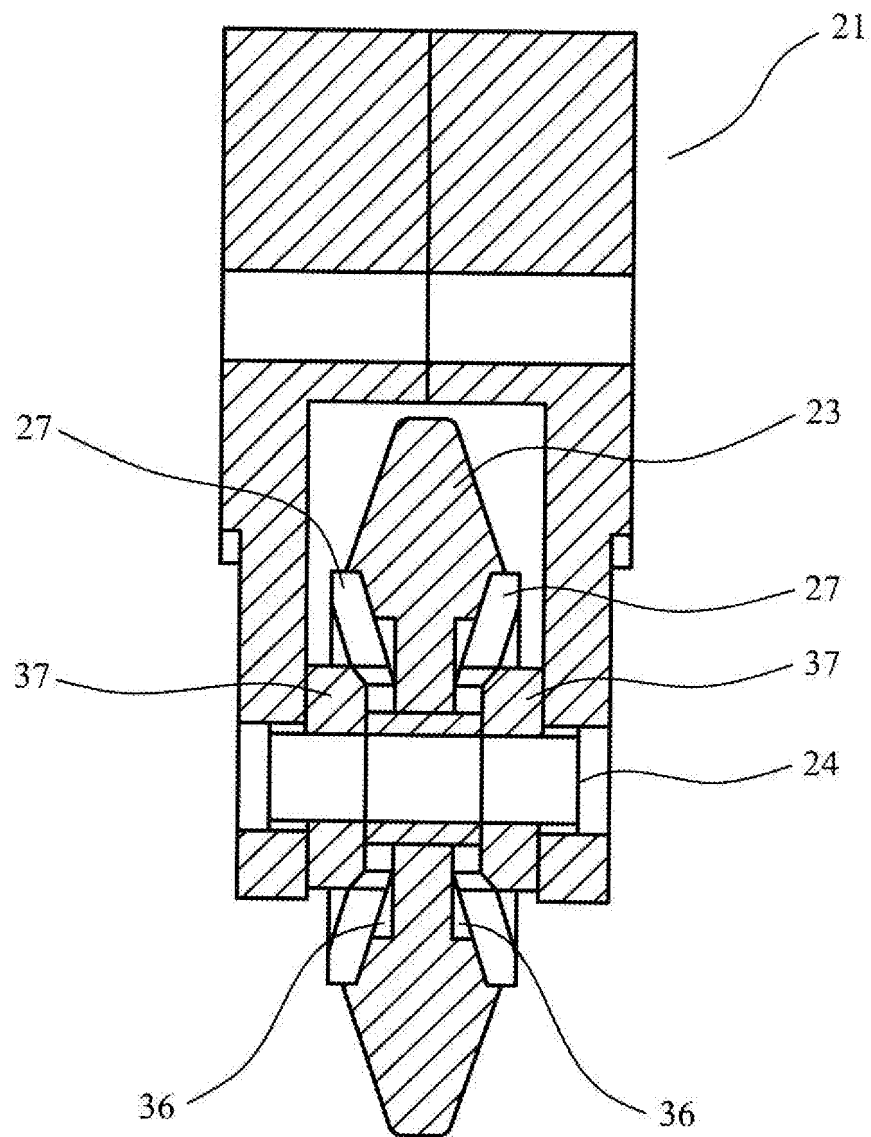


Figure 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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