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(54) **CIRCUIT BREAKER**

(57) A circuit breaker having an optimized structure, the circuit breaker comprising a circuit breaker housing, a release (5), a locking mechanism (4), an operating mechanism (2), a contact system (3), and an arc extinguishing system (6). The contact system comprises a moving contact (31) and a stationary contact, the moving contact moves relative to the stationary contact to implement connection or disconnection, and the movement of the moving contact forms a moving track. The contact system is approximately arranged at a central position, and the release, the locking mechanism, the operating mechanism, and the arc extinguishing system are approximately arranged on the outer periphery so as to surround the contact system. The moving track of the contact system is located below the contact system, the locking mechanism traverses above the contact system, the release and the operating mechanism are disposed on two sides of the contact system, respectively, and the arc extinguishing system is disposed below the contact system so as to at least partially cover the moving track.

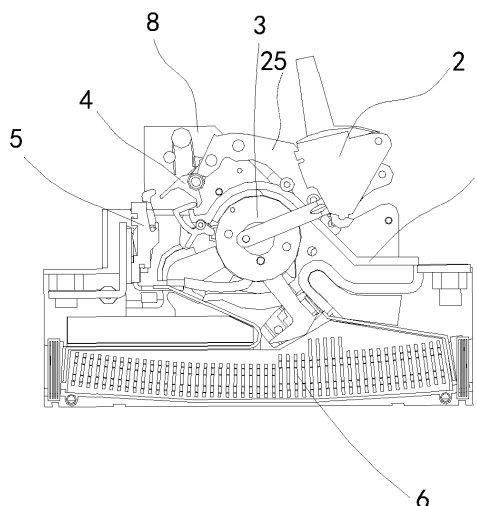


FIG.5

Description

TECHNICAL FIELD

[0001] The present invention relates to a circuit breaker, and more particularly to an improved layout structure of a circuit breaker.

BACKGROUND

[0002] The circuit breaker is a switching device widely used in the power distribution system. The circuit breaker is mainly composed of a release, an operating mechanism, a contact system and an arc extinguishing system. In the conventional common circuit breaker structure, there are common defects caused by the unreasonable arrangement of various mechanisms, such as poor arc extinguishing ability, large space occupation, poor isolation performance, poor versatility and the like. An optimized circuit breaker layout structure is disclosed in the Chinese invention patent application CN108695124A, wherein the contact system and the operating mechanism are arranged on the upper portion of the circuit breaker, the arc extinguishing system is arranged on the lower portion of the circuit breaker, and the release is arranged near the operating mechanism, thereby increasing the length of the arc extinguishing chamber and increasing the number of the arranged arc extinguishing grids. However, in the patent application, since the release is located at the end portion of the arc extinguishing chamber, the release and the fixing structure thereof occupy the length space of the circuit breaker, making the capacity of the arc extinguishing chamber restricted in hardware. That is, the arrangement of arc extinguishing grids of the arc extinguishing system is restricted in the length direction. Moreover, in the patent application, the space between the release and the operating mechanism is relatively small, and in order to ensure the reliability of tripping and releasing, the design requirement (such as location and size precision) of the tripping structure is relatively high.

SUMMARY

[0003] To overcome the above problems, the present disclosure proposes a structurally improved circuit breaker.

[0004] The present disclosure proposes a circuit breaker, including a circuit breaker housing, a release, a locking mechanism, an operating mechanism, a contact system and an arc extinguishing system. The contact system includes a movable contact and a stationary contact. The movable contact moves with respect to the stationary contact to construct a movement trajectory for implementing conduction or interruption. The contact system is approximately arranged at a central position. The release, the locking mechanism, the operating mechanism and the arc extinguishing system are approx-

imately arranged on a periphery in a manner of surrounding the contact system, wherein the movement trajectory of the contact system is located under the contact system, the locking mechanism crosses above the contact system, the release and the operating mechanism are respectively disposed on both sides of the contact system, the arc extinguishing system is disposed under the contact system in a manner of at least partially covering the movement trajectory.

[0005] In order to improve the locking performance and reduce a locking and unlocking torque, in one embodiment, the locking mechanism at least comprises a releasing half shaft and a tripping piece lapped and fitted with the releasing half shaft, the tripping piece crosses above the contact system, the release is linkedly disposed on one side close to the releasing half shaft, the operating mechanism is linkedly disposed on the other side close to the tripping piece.

[0006] In order to improve the safety, in one embodiment, the circuit breaker housing comprises a base, an interior of the base has an approximately enclosed installation space, the contact system and the arc extinguishing system are both located in the installation space.

[0007] In order to maintain and install the locking mechanism and the operating mechanism easily, in one embodiment, the circuit breaker housing further comprises a base plate located on the base, the base plate forms an opened space, the locking mechanism and the operating mechanism are both located in the opened space.

[0008] In order to improve arc extinguishing effect, in one embodiment, the arc extinguishing system is disposed under the contact system in a manner of entirely covering the movement trajectory, and a length of the arc extinguishing system is approximately equal to a maximum length of the circuit breaker housing.

[0009] In order to increasing the running arc distance of the electric arc and improving the arc extinguishing effect, in one embodiment, the arc extinguishing system comprises a first running arc channel relatively close to the movable contact, a second running arc channel relatively close to the stationary contact, and an arc extinguishing grid set, wherein the first running arc channel has an abdication space in which the movable contact moves along the movement trajectory, the arc extinguishing grid set is disposed under the movable contact and the stationary contact, the first running arc channel is flush with one tip of the arc extinguishing grid set, the second running arc channel is flush with the other tip of the arc extinguishing grid set.

[0010] The present disclosure further proposes a multi-pole circuit breaker, including N single-pole circuit breakers. The N single-pole circuit breakers arranged side by side are referred as to be a multi-pole circuit breaker, $2 \leq N \leq 4$, wherein at least one single-pole circuit breaker is the circuit breaker mentioned above.

[0011] In order to ensure the whole effect, in one embodiment, the single-pole circuit breaker includes at least

one of the circuit breaker housing, the release, the contact system and the arc extinguishing system, that is, a part of the single-pole circuit breakers exclude the locking mechanism and the operating mechanism of the circuit breaker mentioned above.

[0012] In order to improve the common use of the multi-pole circuit breaker and reduce the number of the parts, in one embodiment, contact systems of the single-pole circuit breakers are linked in series through a connecting structure, to achieve simultaneous movement of the contact systems of the N single-pole circuit breakers.

[0013] In order to improve isolation performance, ensure safety and prevent cross-arcing, in one embodiment, the contact system and the arc extinguishing system of any two adjacent single-pole circuit breakers are isolated by the circuit breaker housing.

[0014] The present disclosure has following beneficial effects: by improving arrangement of the internal structure of the circuit breaker, the length space of the circuit breaker housing is fully used to maximize the number of arc extinguishing grids and enhance the arc extinguishing effect. The size of tripping piece on the locking end is increased, the lever ratio of the tripping piece forced is improved, the locking and unlocking torque is reduce, and furthermore, the reliability of the releasing can be improved. At the same time, the design space is large for help to design and installation. The single-pole modules may be spliced to be the multi-pole product according to the actual requirement, which can improve the universality of the parts, reduce the number of the parts, and improve the flexibility of the product application and application occasions. And it has great sealing and isolation, thereby improving the safety of use.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a perspective view (angle 1) of a circuit breaker according to one embodiment of the present disclosure.

Fig. 2 is a perspective view (angle 2) of the circuit breaker according to the embodiment of the present disclosure.

Fig. 3 is an exploded view (angle 1) of the circuit breaker according to the embodiment of the present disclosure.

Fig. 4 is an exploded view (angle 2) of the circuit breaker according to the embodiment of the present disclosure.

Fig. 5 is a schematic view of an internal structure of the circuit breaker according to the embodiment of the present disclosure.

Fig. 6 is a schematic view of a circuit breaker housing according to one embodiment of the present disclosure.

Fig. 7 is a schematic view of a multi-pole circuit breaker according to one embodiment of the present

disclosure.

Fig. 8 is a schematic view that contact systems of the multi-pole circuit breaker according to the embodiment of the present disclosure are connected in series through connecting pins.

Fig. 9 is a schematic view of arrangement of a movable terminal, a stationary terminal and the contact system of the circuit breaker according to the embodiment of the present disclosure.

Fig. 10 is an exploded view of the contact system according to the embodiment of the present disclosure.

Fig. 11 is a schematic view that the movable contact and the movable terminal are connected by flexible wires according to one embodiment of the present disclosure.

Fig. 12 is a perspective view of a movable terminal, a stationary terminal and a contact system of the circuit breaker according to the embodiment of the present disclosure.

Fig. 13 is a perspective view of a wheel according to the embodiment of the present disclosure.

Fig. 14 is a schematic view of assembling a second link, a wheel and a base according to the embodiment of the present disclosure.

Fig. 15 is a schematic view that the stationary terminal and the movable terminal are conducted according to the embodiment of the present disclosure.

Fig. 16 is a schematic view that the stationary terminal and the movable terminal are disconnected according to the embodiment of the present disclosure.

Fig. 17 is a schematic arrangement view of the arc extinguishing system in the embodiment of present disclosure.

Fig. 18 is an exploded view of the arc extinguishing system in the embodiment of present disclosure.

Fig. 19 is a perspective view of a first running arc channel according to the embodiment of the present disclosure.

Fig. 20 is a perspective view of a second running arc channel according to the embodiment of the present disclosure.

Fig. 21 is a schematic view of assembling the first running arc channel, the second running arc channel and the arc extinguishing grid set according to the embodiment of the present disclosure.

Fig. 22 is a schematic view of assembling the first running arc channel, the second running arc channel and the arc extinguishing grid set according to the embodiment of the present disclosure.

Fig. 23 is a perspective view of a first magnetism increasing block according to one embodiment of the present disclosure.

Fig. 24 is a perspective view of a second magnetism increasing block according to one embodiment of the present disclosure.

Fig. 25 is a schematic arrangement view of a magnetism increasing block assembly according to one

embodiment of the present disclosure (I).

Fig. 26 is a schematic arrangement view of the magnetism increasing block assembly according to the embodiment of the present disclosure (II).

Fig. 27 is a cross-sectional view taken along a line A-A in Fig. 26, showing the schematic arrangement view of the magnetism increasing block assembly (III).

Fig. 28 is a schematic arrangement view of the magnetism increasing block assembly in the embodiment of present disclosure (IV).

Fig. 29 is a cross-sectional view taken along a line B-B in Fig. 28, showing a schematic arrangement view of the magnetism increasing block assembly (V).

Fig. 30 is a schematic view of an electric arc at a first arc running stage according to one embodiment of the present disclosure.

Fig. 31 is a schematic view of the electric arc at a second arc running stage according to the embodiment of the present disclosure.

Fig. 32 is a perspective view of an internal structure excluding the arc extinguishing system of the circuit breaker according to the embodiment of the present disclosure (I).

Fig. 33 is a perspective view of an internal structure excluding the arc extinguishing system of the circuit breaker according to the embodiment of the present disclosure (II).

Fig. 34 is an exploded view of an operating mechanism, a locking mechanism and a contact system according to the embodiment of the present disclosure.

Fig. 35 is a perspective view of a handle according to the embodiment of the present disclosure.

Fig. 36 is a perspective view of a first link according to the embodiment of the present disclosure.

Fig. 37 is a perspective view of a second link according to the embodiment of the present disclosure.

Fig. 38 is a perspective view of a tripping piece according to the embodiment of the present disclosure.

Fig. 39 is a perspective view of a releasing half shaft according to the embodiment of the present disclosure (I).

Fig. 40 is a schematic view of arrangement positions of the operating mechanism, the locking mechanism and the contact system according to the embodiment of the present disclosure.

Fig. 41 is a perspective view of assembling positions of the operating mechanism, the locking mechanism and the contact system according to the embodiment of the present disclosure.

Fig. 42 is a schematic view of the operating mechanism, the locking mechanism and the contact system of the circuit breaker in a closed state according to the embodiment of the present disclosure.

Fig. 43 is a schematic view of the operating mechanism, the locking mechanism and the contact system

of the circuit breaker in an opened state according to the embodiment of the present disclosure.

Fig. 44 is a schematic view of the operating mechanism, the locking mechanism and the contact system of the circuit breaker in a tripping state according to the embodiment of the present disclosure.

Fig. 45 is a schematic view of the first link at a dead center position in a process from opening to closing of the circuit breaker according to the embodiment of the present disclosure.

Fig. 46 is a schematic view of the first link at the dead center position in a process from closing to opening of the circuit breaker according to the embodiment of the present disclosure.

Fig. 47 is a schematic view of a wheel and a limiting groove for rotationally limiting the wheel according to the embodiment of the present disclosure.

Fig. 48 is a schematic view of assembling a releasing half shaft and a traction element with the circuit breaker housing according to the embodiment of the present disclosure.

Fig. 49 is a perspective view of the releasing half shaft according to the embodiment of the present disclosure (II).

Fig. 50 is a perspective view of the releasing half shaft according to the embodiment of the present disclosure (III).

Fig. 51 is a perspective view of a traction element according to the embodiment of the present disclosure.

Fig. 52 is a schematic view of a working principle of a second releasing combination according to the embodiment of the present disclosure when a loop is conducted.

Fig. 53 is a schematic view of a working principle of the second releasing combination according to the embodiment of the present disclosure when the movable contact is repelled.

Fig. 54 is a schematic view of a working principle of the second releasing combination according to the embodiment of the present disclosure when tripping piece is unlocked.

Fig. 55 is a schematic view that a third link pushed by the movable contact according to the embodiment of the present disclosure.

Fig. 56 is a schematic view of a first releasing combination according to the embodiment of the present disclosure.

Fig. 57 is a schematic view of a releasing half shaft in the multi-pole circuit breaker according to the embodiment of the present disclosure.

Fig. 58 is a schematic view of the circuit breaker according to the embodiment of the present disclosure.

Fig. 59 is a schematic structural view of an arc extinguishing chamber assembly, a contact system and a distributor according to the embodiment of the present disclosure.

Fig. 60 is a perspective view of the arc extinguishing

chamber assembly according to the embodiment of the present disclosure.

Fig. 61 is a exploded view of the arc extinguishing chamber assembly according to the embodiment of the present disclosure.

Fig. 62 is a front view of the arc extinguishing chamber assembly and the movable contact according to the embodiment of the present disclosure.

Fig. 63 is a T-direction view in Fig. 62.

Fig. 64 is a partial enlarged view at M in Fig. 63.

Fig. 65 is a perspective view of a first partition plate according to the embodiment of the present disclosure.

Fig. 66 is a front view of the arc extinguishing chamber assembly according to the embodiment of the present disclosure.

Fig. 67 is a sectional view taken along a line N-N in Fig. 66.

Fig. 68 is a schematic view that the first partition plate and the arc extinguishing grid set according to the embodiment of the present disclosure are installed together.

Fig. 69 is a schematic view of the distributor according to the embodiment of the present disclosure (position 1).

Fig. 70 is a schematic view of the distributor according to the embodiment of the present disclosure (position 2).

Fig. 71 is a schematic view of a first insulating plate, a second insulating plate and an arc extinguishing grid according to another embodiment of the present disclosure.

Fig. 72 is a schematic view that the first insulating plate and the second insulating plate are installed on the arc extinguishing grid according to another embodiment of the present disclosure.

Fig. 73 is a schematic view of a partition plate according to another embodiment of the present disclosure.

Fig. 74 is a schematic view the first insulating plate and the second insulating plate are installed on the arc extinguishing grid set according to another embodiment of the present disclosure.

Fig. 75 is a schematic view of the arc extinguishing system according to the embodiment of the present disclosure.

Fig. 76 is an exploded view of the arc extinguishing system according to the embodiment of the present disclosure.

Fig. 77 is a schematic view of the arc extinguishing grid, the first insulating rod and the second insulating rod according to the embodiment of the present disclosure.

Fig. 78 is a schematic view that the arc extinguishing grid according to the embodiment of the present disclosure is assembled within a clamping groove on the first clamping plate.

Fig. 79 is a front view of the arc extinguishing system

according to the embodiment of the present disclosure.

Fig. 80 is a sectional view taken along D-D in Fig. 79.

Fig. 81 is a sectional view taken along E-E in Fig. 79.

Fig. 82 is a schematic view of an arc extinguishing system according to another embodiment of the present disclosure.

Fig. 83 is an exploded view of the arc extinguishing system according to another embodiment of the present disclosure.

Fig. 84 is a schematic view of the arc extinguishing grid and the insulator embedded and fixed integrally according to another embodiment of the present disclosure.

Fig. 85 is an exploded view of the arc extinguishing grid and the insulator according to another embodiment of the present disclosure.

Fig. 86 is a schematic view of an insulator according to another embodiment of the present disclosure.

DETAILED DESCRIPTION

[0016] Example embodiments will now be described more fully with reference to the accompanying drawings.

Example embodiments, however, can be embodied in various forms and should not be construed as limited to the embodiments set forth herein. Although relative terms, such as "upper" and "lower" are used in this specification to describe the relative relationship of one component to another component as illustrated in the drawings, these terms are used in this specification only for convenience, for example, according to the direction of the example as illustrated in the drawings. It can be understood that if the device as illustrated in the drawings is turned over, components described as being "upper" would then be components that are "lower". Other relative terms, such as "top" and "bottom" also have similar meanings. When a structure is "on" the other structure, it may mean that the structure is integrally formed on the other structure, or that the structure is "directly" disposed on the other structure, or that the structure is "indirectly" disposed on the other structure through another structure.

[0017] The terms "a", "an", "the" and "said" are used to indicate the presence of one or more elements/components/etc. The terms "comprise" and "have" are used to indicate an open-ended inclusion and to mean that additional elements/components/etc. may be present in addition to the listed elements/components/etc. The terms "first" and "second" etc. are used only as labels and are not intended to limit the number of their objects.

[0018] The present invention is provided with accompanying drawings to further illustrate the various embodiments. These accompanying drawings are a portion of the disclosure of the present invention, which are mainly used to illustrate the embodiments, and can be combined with related descriptions in the specification to explain the operating principles of the embodiments. With refer-

ence to these contents, those skilled in the art should understand other possible embodiments and advantages of the present invention. Components in the figures are not drawn to scale, and like reference numerals generally refer to like components.

[0019] Referring to Figs. 1 to 5, the preferred embodiment of the circuit breaker of the present invention includes a housing, and an operating mechanism 2, a contact system 3, a locking mechanism 4, a release 5 and an arc extinguishing system 6 installed on the housing, wherein the locking mechanism 4 and the release 5 cooperate with each other. As shown in Fig. 5, the contact system 3 is approximately located at the middle position, the release 5 is disposed on the upper left side of the contact system 3, the operating mechanism 2 is disposed on the upper right side of the contact system 3, the arc extinguishing system 6 is disposed below the contact system 3, and the length of the arc extinguishing system 6 is almost equal to the maximum length of the circuit breaker housing, which fully utilizes the length space of the housing of the circuit breaker, maximizes the number of the arranged arc extinguishing grids of the arc extinguishing system 6, and improves the ability of arc extinguishing. The locking mechanism 4 includes a tripping piece 25 (see Fig. 41), the tripping piece 25 crosses above the contact system 3, one end thereof is lapped on the releasing half shaft 41, the release 5 and the operating mechanism 2 at both ends thereof are disposed separately so that the tripping piece 25 may make full use of the length space of the circuit breaker, the size of the tripping piece 25 at the locking end may be increased, the leverage ratio of the force on the tripping piece 25 may be improved, and the releasing torque of locking may be reduced, thereby improving the reliability of releasing. At the same time, the space is designed relatively large, which is also convenient for design and installation.

[0020] Referring to Figs. 1, 2 and 6, the circuit breaker housing includes a base 1 and a base plate 8. The base 1 includes a first base 1' and a second base 1". The first base 1' and the second base 1" are combined to form an approximately enclosed interior space capable of accommodating the contact system 3, the release 5 and the arc extinguishing system 6, so as to prevent the free gas generated by an internal electric arc from escaping and affecting the safety of persons. The base plate 8 includes a first base plate 8' and a second base plate 8" disposed opposite to each other. The first base plate 8' and the second base plate 8" are fixed on the first base 1' and the second base 1", respectively. An installation space where the operating mechanism 2 and the locking mechanism 4 may be installed is formed between the first base plate 8' and the second base plate 8". The operating mechanism 2 and the locking mechanism 4 are disposed outside the base 1, which can facilitate installation and improve the convenience of product maintenance. The base 1 and the base plate 8 constitute the installation base body of the operating mechanism 2, the contact system 3, the locking mechanism 4, the release 5 and

the arc extinguishing system 6 in the present embodiment. The housing and the operating mechanism 2, the contact system 3, the locking mechanism 4, the release 5 and the arc extinguishing system 6 installed on the housing constitute an independent single-pole circuit breaker module (see Fig. 2). A plurality of single-pole circuit breaker modules may be spliced together to form a multi-pole circuit breaker module, and connected in series through a connection pin 9 between the respective contact systems 3 to realize synchronous pole connection (see Figs. 7 and 8). The contact system 3 is a main movement part that controls the opening and closing of the circuit breaker (refer to the following for its specific principle). Since the multi-pole circuit breaker module has a plurality of contact systems 3 that move synchronously, only one operating mechanism 2 is required to control the opening and closing of the circuit breaker. Each independent single-pole circuit breaker module is separated by the circuit breaker housing, which can prevent the free gas generated by the electric arc of one pole from escaping to other adjacent poles, and improve the reliability of interruption.

[0021] For the convenience of description, the present embodiment is described with a single-pole circuit breaker module having an operating mechanism 2.

[0022] Referring to Fig. 9, the circuit breaker has a stationary terminal 10 and a movable terminal 11 as electrical connection terminals. The stationary terminal 10 and the movable terminal 11 are disposed separately on both sides of the contact system 3, and to control the conduction and interruption between the stationary terminal 10 and the movable terminal 11 through the contact system 3. The contact system 3 realizes the breaking by means of rotation. Specifically, referring to Figs. 10 and 12, the contact system 3 includes an approximately "J"-shaped movable contact 31 and a hollow circular wheel 32. The wheel 32 is rotatably connected to the base 1, and the movable contact 31 is rotatably connected to the wheel 32. Specifically, referring to Figs. 13 and 14, in the present embodiment, the wheel 32 has a circular protruding post 321 at its central position, and the circular protruding post 321 may be fittingly connected to an circular installation hole 1'1 on the first base 1' (the size of the installation hole 1'1 matches the size of the protruding post 321, with a clearance fit), so as to realize the rotatable connection between the wheel 32 and the first base 1'. It is easy to imagine that the wheel 32 may be disposed with two circular protruding posts 321 fittingly connected with the first base 1' and the second base 1" on both sides of the wheel 32 respectively, to increase the stability of the connection and movement of the wheel 32.

[0023] Referring to Figs. 10, 11 and 13, the movable terminal 11 is electrically connected (welded) with the movable contact 31 through the flexible wire 12. The movable contact 31 has a through hole 311 thereon. The movable contact 31 is connected by a pin through the through hole 311 thereof and the installation hole 322 on the wheel 32 with the wheel 32; thereby the movable

contact 31 is rotatably connected to the wheel 32.

[0024] Referring to Figs. 15 and 16, Figs. 15 and 16 respectively illustrate situations of conduction (a feasible current flow direction is shown with an arrow in Fig. 15 for easy understanding) and interruption between the stationary terminal 10 and the movable terminal 11. The stationary terminal 10 has one stationary contact thereon, the stationary contact includes a stationary point 101, and the movable contact 31 has one movable point 312 thereon. The wheel 32 may be driven to rotate by the driving of the operating mechanism 2 or under the tripping motion of the locking mechanism 4 (please refer to the following for the specific operating principle), so as to drive the movable contact 31 to approach or move away from the stationary terminal 10. When the movable contact 31 approaches the stationary terminal 10, the movable point 312 abuts against the stationary point 101, and the stationary terminal 10 and the movable terminal 11 are conducted. When the movable contact 31 moves away from the stationary terminal 10, the stationary terminal 10 and the movable terminal 11 are interrupted. The state of the contact system 3 shown in Figs. 15 and 16 is the state of the contact system 3 under the closing and opening of the circuit breaker.

[0025] Refer to Fig. 15, in the state where the stationary terminal 10 and the movable terminal 11 are conducted, the movable contact 31 is separated from the stationary point 101 by the repulsive force, or the wheel 32 drives the movable contact 31 to gradually move to separate the movable contact 31 from the stationary point 101. The initial distance between the movable contact 31 and the stationary point 101 is relatively small, and the electric field intensity is relatively high. In the case that electrons are continuously collided and dissociated, electric arcs are generated between the contacts. It is one of the important functions of the circuit breaker to quickly and effectively extinguishing the electric arc generated when the circuit breaker is interrupted. To this end, an arc extinguishing system 6 with an optimized structure is designed in the embodiment.

[0026] For the convenience of description, the position and orientation are defined as follows:

[0027] The position of the first base 1' relative to the second base 1'' illustrated in the Fig. 6 is defined as a front direction, and the position of the second base 1'' relative to the first base 1' is defined as a rear direction;

[0028] The position of the movable terminal 11 relative to the stationary terminal 10 illustrated in the Fig. 9 is defined as a left side, and the position of the stationary terminal 10 relative to the movable terminal 11 is defined as a right side;

[0029] The movable terminal 11 and the stationary terminal 10 illustrated in the Fig. 9 are defined to be relatively located above the arc extinguishing system 6, and the arc extinguishing system 6 is defined to be located relatively below the movable terminal 11 and the stationary terminal 10.

[0030] Refer to Figs. 17 and 18, together with Fig. 5,

the movement of the movable contact 31 relative to the stationary contact is defined to construct a motion track for realizing conduction or interruption. The arc extinguishing system 6 approximately covers the motion track (in other embodiments, the arc extinguishing system 6 may also at least partially cover the motion track). The arc extinguishing system 6 includes a first running arc channel 61, a second running arc channel 62, an arc extinguishing grid set 63, a first magnetism increasing block 64, a second magnetism increasing block 65 and a third magnetism increasing block 66. Wherein, the first running arc channel 61 and the second running arc channel 62 are arranged on the left and right sides of the movable contact 31 respectively, and are electrically connected with the movable terminal 11 and the stationary terminal 10 respectively (the movable terminal 11 in Figs. 17 and 18 only illustrates one end connected with the movable contact 31 through the flexible wire 12). Referring to Fig. 19, the first running arc channel 61 is approximately a bent sheet-shape structure, including a base body portion 611, an electrical connection portion 613, an engaged portion 612 and a bending portion 614. The base body portion 611 serves as a main running arc channel of the first running arc channel 61. The electrical connection portion 613 is located above the base body portion 611 and is used for electrically connecting with the movable terminal 11, and the right end of the base body portion 611 is close to the movable contact 31. The engaged portion 612 connects the base body portion 611 and the electrical connection portion 613. The engaged portion 612 and the base body portion 611 are approximately V-shaped, so that the first running arc channel 61 itself has a V-shaped semi-enclosed space where the second magnetism increasing block 65 may be installed. The engaged portion 612 is disposed in a misaligned position with the movable contact 31, so as not to interfere with the movement of the movable contact 31. The bending portion 614 serves as a secondary running arc channel of the first running arc channel 61. In the process of the electric arc being continuously elongated and extinguished, the arc runs on the base body portion 611 first. If the arc is not completely extinguished at the base body portion 611, it will eventually move to the bending portion 614 to reach the longest electric arc length on the hardware. The bending portion 614 further has a vent hole 610 (refer to Fig. 21), which is used for ventilation and heat dissipation when the arc extinguishing system 6 extinguishes the arc, so that the gas generated by the electric arc combustion may be quickly discharged through the vent hole 610.

[0031] Referring to Fig. 20, the second running arc channel 62 includes a base body portion 621, an electrical connection portion 622 and a bending portion 623. The base body portion 621 serves as a main running arc channel of the second running arc channel 62, and the electrical connection portion 622 is formed by bending one end of the base body portion 621 for electrically connecting with the stationary terminal 10. The bending por-

tion 623 serves as a secondary running arc channel of the second running arc channel 62. In the process of the electric arc being continuously elongated and extinguished, the arc runs on the base body portion 621 first. If the arc is not completely extinguished at the base body portion 621, it will eventually move to the bending portion 623 to reach the longest electric arc length on the hardware. The bending portion 623 further has a vent hole 620, which is used for ventilation and heat dissipation when the arc extinguishing system 6 extinguishes the arc. A semi-enclosed space where the third magnetism increasing block 66 may be installed is formed between the second running arc channel 62 and the stationary terminal 10.

[0032] Referring back to Figs. 17 and 18, the arc extinguishing grid set 63 is disposed below the movable contact 31, and the arc extinguishing grid set 63 is composed of a plurality of arc extinguishing grids arranged approximately from left to right, and the bottom of the arc extinguishing grid set 63 is approximately arc-shaped. The length of the arc extinguishing grid set 63 is roughly equal to the length of the base 1 in the left-right direction, which fully utilizes the length space inside the base 1 and maximizes the arrangement number of the arc extinguishing grids.

[0033] Referring to Figs. 21 and 22, a clamping plate 67 may be disposed before and after the arc extinguishing grid set 63 to facilitate the installation of the arc extinguishing grid set 63. The arc extinguishing grid set 63 is formed by installing the arc extinguishing grids on the clamping plate 67 one by one (installation methods such as clamping, etc.). The bending portion 614 of the first running arc channel 61 and the bending portion 623 of the second running arc channel 62 are respectively located at the left and right ends of the arc extinguishing grid set 63, and then the first running arc channel 61, the second running arc channel 62, the clamping plate 67, and the circuit breaker housing located below the arc extinguishing grid set 63 form an approximately enclosed arc extinguishing space, with only the vent holes 610 and 620, so as to implement ventilation and heat dissipation in the arc extinguishing system 6. Thus, it can effectively prevent the arc from arc-crossing into other chambers, burning electronic devices or causing arc extinguishing failure. It is illustrated in Fig. 22 that a filter screen 13 is located at both ends of the arc extinguishing grid set 63 and outside the bending portions 614, 623. The filter screen 13 is used to eliminate the ionization of the charged gas and then discharge it to achieve the effect of zero flashover.

[0034] While maximizing the length of the arc extinguishing chamber and the number of arc extinguishing grids on the hardware, in order to increase the running arc speed of the electric arc, the embodiment a magnetism increasing component including two first magnetism increasing blocks 64, a second magnetism increasing block 65 and a third magnetism increasing block 66 is further disposed that can improve arc extinguishing effi-

ciency. Referring to Figs. 17, 18 and 23, the two first magnetism increasing blocks 64 are arranged oppositely on the front and rear sides of the movable contact 31. The first magnetism increasing block 64 is an approximately "Z"-shaped block structure, on which there is an expansion tube structure 641 and a J-shaped buckle structure 642, so as to be clamp-fitted and fixed with the base 1 (correspondingly, the base 1 may be provided with an installation hole and a clamp groove, which are obviously achievable). Referring to FIGS 17, 18 and 24, the second magnetism increasing block 65 is an approximately rectangular block structure, and is installed in the V-shaped semi-enclosed space of the first running arc channel 61. In order to fit the shape of the first running arc channel 61, the second magnetism increasing block 65 is also cut at the V-shaped rounded corner close to the first running arc channel 61. The second magnetism increasing block 65 has a first U-shaped groove 650, and the first U-shaped groove 650 may accommodate the movable contact 31 to move therein.

[0035] Referring to Figs. 17 and 18, the third magnetism increasing block 66 is installed between the second running arc channel 62 and the stationary terminal 10, and shape thereof matches the semi-enclosed curve surrounded by the second running arc channel 62 and the stationary terminal 10.

[0036] Referring to Figs. 25-29, the width of the third magnetism increasing block 66 is larger than the width of the stationary terminal 10 and the second running arc channel 62, so that the third magnetism increasing block 66 has a portion that exposes from the second running arc channel 62 in the front-rear direction, and the third magnetism increasing block 66 is engaged with the first magnetism increasing block 64 at the exposed portion thereof. Specifically, with reference to Fig. 23 and 25, an end 643 of the first magnetism increasing block 64 abuts against the exposed portion of the third magnetism increasing block 66, so that the first magnetism increasing block 64 and the third magnetism increasing block 66 disposed oppositely encircle to form a U-shaped semi-enclosed space, which is defined as a second U-shaped groove 640. The second U-shaped groove 640 and the first U-shaped groove 650 of the second magnetism increasing block 65 encircle to form an approximately enclosed movement area of the movable contact 31 (refer to Fig. 27). In the movement stroke of opening and closing of the movable contact 31, the movable contact 31 is always in the movement area, and obviously, the shape and size of the first U-shaped groove 650 and the second U-shaped groove 640 may be reasonably designed to fit the movement stroke of the movable contact 31.

[0037] The first magnetism increasing block 64, the second magnetism increasing block 65, and the third magnetism increasing block 66 serving as magnetism increasing components are all magnetizers, which are used to enhance the magnetic field strength generated by the current flowing in the encircled area thereof (the first U-shaped groove 650 and the second U-shaped

groove 640), to increase the Lorentz force on the electric arc to quickly elongate the electric arc. The specific principle is as follows:

[0038] I. The first running arc stage: Referring to Fig. 30, a feasible current flow direction (current flowing from the stationary terminal 10 to the movable terminal 11) is shown by an arrow to assist in the description. When the movable contact 31 of the movable terminal 11 and the stationary contact of the stationary terminal 10 start to separate, the stationary contact has a current in the direction of X1 thereon, the movable contact 31 has a current in direction of Y1 thereon, an electric arc 200 is generated between the movable contact 31 and the stationary contact, and the current of the electric arc 200 flows from the stationary contact to the movable contact 31. According to the right-hand circuital law, the movable contact 31 and the stationary contact simultaneously generate a magnetic field approximately from the front to the rear direction, and then the electric arc 200 between the movable contact 31 and the stationary contact is subjected to an approximately downward ampere force F1 according to the left-hand rule. At this time, since the movable contact 31 and the stationary contact are located in the second U-shaped groove 640 area encircled by the first magnetism increasing block 64 and the third magnetism increasing block 66 of the magnetic increasing components, the magnetic field generated by the movable contact 31 and the stationary contact is enhanced, the ampere force F1 received by the electric arc 200 is also enhanced, and the electric arc 200 moves downwards rapidly under the action of the ampere force F1.

[0039] II. The second running arc stage: Referring to Fig. 31, in the process of the electric arc 200 gradually moving downward, due to the join between the second running arc channel 62 and the stationary terminal 10, a right end of the electric arc 200 gradually moves from the stationary contact to the second running arc channel 62. A left end of the electric arc 200 is initially on the movable contact 31, on the one hand, the potentials of the first running arc channel 61 and the movable contact 31 are equal, on the other hand, in the embodiment, the movable contact 31 may move at the upper right position close to the first running arc channel 61 by disposing the first U-shaped groove 650. Moreover, the hook-shaped tip of the "J"-shaped movable contact 31 is designed toward the first running arc channel 61, which generally makes the movable contact 31 relatively close to the first running arc channel 61. When the movable contact 31 and the stationary contact start to separate, the left end of the electric arc 200 jumps from the movable contact 31 to the first running arc channel 61, so as to avoid the movable contact 31 being ablated by the electric arc for a long time, and to improve electrical performance of the contacts. Referring to Fig. 31, the two ends of the electric arc 200 are behind the first running arc channel 61 and the second running arc channel 62. At this time, the stationary contact has a current in the direction of X2, and

the movable contact 31 has a current in the direction of Y2. According to the right-hand circuital law, the movable contact 31 and the stationary contact generate a magnetic field from the front to the rear direction between each other at the same time. According back to the left-hand rule, the left end of the electric arc 200 is subjected to an approximately leftward Ampere force F2, and the right end of the arc 200 is subjected to an approximately rightward Ampere force F3. Under the action of the ampere force F2 and F3, the electric arc 200 rapidly moves to the arc extinguishing grids on both sides, so that each grid may fully cut the electric arc. At the same time, the electric arc 200 is elongated, further limiting the current rise, reducing the impact on the power system, reducing the electric arc voltage rising speed, and shortening the electric arc extinguishing time.

[0040] Referring back to Figs. 17 and 18, it can be seen that the height of several arc extinguishing grids under the stationary contacts of the arc extinguishing grid set 63 is relatively high, and its main design consideration is to increase the movement speed of the electric arc when the electric arc is in the first running arc stage, so as to quickly enter the arc extinguishing chamber for arc extinguishing.

[0041] On one hand, the overall layout in the embodiment and the design for the arc extinguishing system 6 maximize the length of the arc extinguishing chamber and the number of arc extinguishing grids, which fully utilizes the length and size of the circuit breaker housing, and also improves the running arc speed of the electric arc, thereby improving the arc extinguishing efficiency.

[0042] In the embodiment, two first magnetism increasing blocks 64 and one third magnetism increasing block 66 are connected to form a U-shaped groove structure surrounding the movable contact 31 and the stationary contact, which is convenient for the installation of the magnetism increasing blocks. In other embodiments, the first magnetism increasing block 64 and the third magnetism increasing block 66 may also be an integral formed structure with a U-shaped groove.

[0043] The opening and closing of the circuit breaker is determined by the movement of the movable contact 31. The operating mechanism 2 is the main structure for controlling the movement of the movable contact 31, and meanwhile, the operating mechanism 2 is matched with the locking mechanism 4, so that the movable contact 31 may move when the circuit breaker is tripped.

[0044] Figs. 32 and 33 illustrate perspective views of the internal structure of the circuit breaker (not including the arc extinguishing system 6), and Fig. 34 illustrates a structural exploded view of the internal structure of the circuit breaker (not including the arc extinguishing system 6). Referring to Figs. 34-37, the operating mechanism 2 includes a handle 21, a pull spring 22, a first link 23 and a second link 24. The handle 21 has two opposite convex circles 210 for assembling with the circuit breaker housing. The first link 23 includes two arc-shaped long piece bodies 230 arranged at intervals, the two long piece bod-

ies 230 are fixedly connected together by a connection pin 233, the first link 23 is provided with through holes 231, 232 for rotational connection with other components, and the connection pin 233 has an arc-shaped groove for the assembly of the pull spring 22. The second link 24 is roughly in a "H" shape and includes two bar-shaped rods 242 disposed at intervals and fixedly connected by a connection pin 243. The second link 24 is provided with through holes 240 and 241 for rotational connection with other components. Referring to Figs. 38-39, the locking mechanism 4 includes a releasing half shaft 41 and a tripping piece 25. The tripping piece 25 is an approximately "Y"-shaped structure bonded by two mirror-symmetrical unit piece bodies 250, including two parallel connection portions 251 at intervals, converging portions 252 extending from an end of the connection portions 251 and gradually approaching each other, and lapped portions 253 engaged at an end of the converging portions 252. The connection portions 251 have through holes 254, 255 for rotating connection with other components, the lapped portions 253 are curved in an arc shape, the lapped portions 253 are used to lap on the releasing half shaft 41 to realize quick releasing of the operating mechanism 2.

[0045] Figs. 34, 39 and 41 illustrate the releasing half shaft 41, which is rotatably assembled on the circuit breaker housing and has a groove 412 and a step 411 thereon. The lapped portion 253 of the tripping piece 25 may be lapped on the step 411. When the releasing half shaft 41 rotates, the lapped portion 253 falls into the groove 412, and then the tripping piece 25 releases quickly (for details and principles, please refer to the description below).

[0046] Referring to Figs. 40-41, an assembly manner of individual components of the operating mechanism 2 is illustrated. Wherein, the handle 21 is rotatably assembled on the base plate 8 with its convex circle 210 (as shown in Fig. 41, the convex circle 210 on a side of the handle 21 is assembled on the groove 8"0, which matches the shape of the convex circle 210, on the second substrate 8", associatively, the convex circle 210 on another side of the handle 21 is assembled on the first base plate 8' in the same way), and the handle 21 may swing on the base plate 8 to a certain extent. The tripping piece 25 is rotatably assembled on the base plate 8 with the through hole 255 thereof (as shown in the figure, the through hole 255 on one side of the tripping piece 25 is assembled on the protruding post 8"1, which matches the shape of the through hole 255, on the second substrate 8"), and the tripping piece 25 can swing on the base plate 8 to a certain extent, and the lapped portion 253 of the tripping piece 25 is lapped on the releasing half shaft 41 and may be controlled to trip by the releasing half shaft 41. The first link 23 is rotatably assembled by the through hole 232 of the first link and the through hole 254 of the tripping piece 25 by a pin connection, and the through hole 231 of the first link 23 and the through hole 241 of the second link 24 are rotatably assembled to-

gether by a pin connection. An end of the pull spring 22 is fastened on the connection pin 233 of the first link 23, and another end is fastened on the handle 21, wherein the pull spring 22 is connected to the lower end position of the first link 23 to increase the moment of the steering force generated by the pull spring 22 to the first link 23. Referring to Fig. 14, the through hole 240 of the second link 24 and the through hole 324 of the wheel 32 are rotatably assembled together through a pin connection. The assembled operating mechanism 2 is illustrated in Fig. 40. Although in the present embodiment, the tripping piece 25, the first link 23, and the second link 24 are all three-dimensional structures formed by bonding two symmetrical piece bodies, such a design may increase the stability of mutual movement and force transmission of parts in the operating mechanism 2. However, in other embodiments, it may also be a sheet-shaped structure with only one unit piece body for force transmission and movement. Although the stability is not as good as the present embodiment, the manufacturing cost may be reduced. In addition, in the embodiment, it is worth noting the arrangement of the handle 21, the tripping piece 25, the first link 23 and the second link 24. The tripping piece 25 and the second link 24 are approximately horizontally arranged, and the handle 21 and the first link 23 are approximately vertically arranged. At the same time, in order to improve the stability of the transmission, the first link 23 is also a structure that is approximately inclined to the right side. Such an arrangement makes the handle 21, the tripping piece 25, the first link 23 and the second link 24 alternately arranged in a compact installation area, which makes the structure more compact, drives more efficient and reduce the outer dimension of the circuit breaker while maintaining the stability of the link structure.

[0047] Next, the action principle of the operating mechanism 2 will be described. Figs. 42, 43 and 44 are schematic diagrams of the state of the operating mechanism 2 when the circuit breaker is in the closing, opening and releasing situations respectively. First of all, it should be noted that: First, a pull spring 22 is always in a stretched state, and provides driving force for the operating mechanism 2 with its elastic restoring force; Second, the movement of the movable contact 31 is mainly driven by the rotation of the wheel 32, and the rotation range of the wheel 32 is limited by a limiting mechanism, thereby limiting the stroke of the movable contact 31.

[0048] Referring to Fig. 47, the wheel 32 is provided with a limiting raised portion 325 in its radial direction, and a limiting groove for limiting the limiting raised portion 325 is opened on the base 1 (as shown in Fig. 47, the limiting groove 1"0 on the second base 1" is illustrated). When the wheel 32 rotates, the rotation angle thereof is limited in the limiting groove, so the swing range of the movable contact 31 is also limited by the limiting groove. Through the matching and limiting of the limiting raised portion 325 and the limiting groove, the movement amount of the movable contact 31 may be prevented

from being too large, so that intense collision between the movable contact 31 and the stationary contact or other components is avoided, and overshoot is prevented. In the embodiment, the limiting raised portion 325 on the wheel 32 is matched with the limiting groove (the limiting groove 1"0) on the base 1 to form the rotation limiting structure of the wheel 32, and the limiting raised portion 325 and the limiting groove may be formed by simple molding techniques such as injection molding, so that additional components are omitted to form the limiting mechanism, and the reliability of the structure is improved. The following is the movement principle of the operating mechanism 2, the locking mechanism 4 and the contact system 3:

I. Closing state: Referring to Fig. 42, in the closing state, the tripping piece 25 is lapped on the releasing half shaft 41. The limiting raised portion 325 on the wheel 32 is limited by a right end of the limiting groove on the base 1 and cannot rotate counterclockwise. The movable contact 31 just abuts against the stationary contact 101. The handle 21 is in the closing position close to the left, so that the pull spring 22 is located on the upper left side of the joint A where the first link 23 and the tripping piece 25 are rotatably connected (the first link 23 is connected to the joint A of the tripping piece 25 in rotation, that is, the pin connection between the through hole 232 of the first link 23 and the through hole 254 of the tripping piece 25, the first link 23 can rotate around the joint relative to the tripping piece 25). At this time, the pull spring 22 generates an elastic restoring force FL1 on the first link 23 at the end connected to the first link 23. The elastic restoring force FL1 will force the first link 23 to have a tendency to rotate clockwise relative to the joint A. If the first link 23 rotates clockwise, the second link 24 will move in an arc-shape to the left to push the wheel 32, so that the wheel 32 will rotate counterclockwise, and then the wheel 32 will drive the movable contact 31 to swing to the right. In other words, at this time, the elastic restoring force FL1 makes the movable contact 31 have a tendency to swing to the right, and relying on this tendency, the movable contact 31 can stably abuts against the stationary contact 101.

II. Closing-opening process: Referring to Figs. 42, 46 and 43, in the closing state, the handle 21 is wrenched to swing the handle 21 to the right, and in the process of swinging the handle 21 to the right, the position of the pull spring 22 also changes, until the state of Fig. 46, the joint A is located on the axis of the pull spring 22. At this time, the pressure angle formed by the elastic restoring force FL2 generated by the pull spring 22 on the first link 23 at one end connected with the first link 23 and the movement direction of the first link 23 relative to the joint A is 90° , that is, the first link 23 is at the dead point position. Referring to Fig. 44, from the state of Fig. 46,

the handle 21 continues to be wrenched to the right, the pull spring 22 is initially at the right lower side of the joint A, then the elastic restoring force FL3 generated by the pull spring 22 on the first link 23 at one end connected with the first link 23 will force the first link 23 to rotate counterclockwise relative to the joint A (FL3 generates a moment for counterclockwise rotation of the first link 23 relative to the joint A), and when the first link 23 moves counterclockwise, the second link 24 is moved relatively rightwards to pull the wheel 32, so that the wheel 32 rotates clockwise, and then the wheel 32 drives the movable contact 31 to be separated from the stationary contact until the limiting raised portion 325 on the wheel 32 is limited by the limiting groove on the base 1.

III. Opening state: Referring to Fig. 43, in the opening state, the tripping piece 25 is lapped on the releasing half shaft 41. The limiting raised portion 325 on the wheel 32 is limited by the movable contact 31 and a left end of the limiting groove on the base 1 and cannot rotate clockwise. The handle 21 is in the closing position close to the left, so that the pull spring 22 is located on the lower right side of the joint A. At this time, the pull spring 22 generates an elastic restoring force FL3 on the first link 23 at the end connected to the first link 23. The elastic restoring force FL3 will force the first link 23 to have a tendency to rotate counterclockwise relative to the joint A. If the first link 23 rotates counterclockwise, the second link 24 will move in an arc-shape to the right to pull the wheel 32, so that the wheel 32 will rotate clockwise, and then the wheel 32 will drive the movable contact 31 to swing to the left. In other words, at this time, the elastic restoring force FL3 makes the movable contact 31 have a tendency to swing to the left, and relying on this tendency, the movable contact 31 can stably be located at the opening position.

IV. Opening-closing process: Referring to Fig. 43, 45 and 42, in the opening state, the handle 21 is wrenched to swing the handle 21 to the left, and in the process of swinging the handle 21 to the left, the position of the pull spring 22 also changes, until the state of Fig. 45, the joint A is located on the axis of the pull spring 22. At this time, the pressure angle formed by the elastic restoring force FL4 generated by the pull spring 22 on the first link 23 at one end connected with the first link 23 and the movement direction of the first link 23 relative to the joint A is 90° , that is, the first link 23 is at the dead point position. Referring to Fig. 42, from the state of Fig. 45, the handle 21 continues to be wrenched to the left, the pull spring 22 is initially at the left upper side of the joint A, then the elastic restoring force FL1 generated by the pull spring 22 on the first link 23 at one end connected with the first link 23 will force the first link 23 to rotate clockwise relative to the joint A, and when the first link 23 moves clockwise, the second link 24 is moved relatively leftwards to push the wheel

32, so that the wheel 32 rotates counterclockwise, and then the wheel 32 drives the movable contact 31 to swing to the right until the limiting raised portion 325 on the wheel 32 is limited by the limiting groove on the base 1. At this time, the movable contact 31 is just in contact with the stationary contact.

V. Releasing tripping process: Referring to Figs. 42 and 44 in sequence, in the closing state, the releasing half shaft 41 is triggered to make the tripping piece 25 quickly release and fall (Fig. 44, the releasing principle of the tripping piece 25 at the releasing half shaft 41 is described in detail below), and then the tripping piece 25 will rotate counterclockwise around a joint B thereof with the base plate 8, so that the joint A is driven by the tripping piece 25 to the upper left side of the pull spring 22, and similar to the opening principle (II), the movable contact 31 will be driven to swing to the left and separate from the stationary contact.

VI. Reset process after releasing: Refer to Figs. 44 and 43 in sequence, in the releasing state (Fig. 44), the handle 1 is wrenched to the right to the opening position, and the tripping piece 25 is driven to rotate clockwise around the joint B, so that the tripping piece 25 is re-lapped on the releasing half shaft 41 (the principle of the lapping reset of the tripping piece 25 at the releasing half shaft 41 is described below).

[0049] As can be seen from the above, in the embodiment, the position of the joint A relative to the pull spring 22 is changed (which may be the position change of the joint A, or the position change of the pull spring 22) by the movement between the mechanisms, to change the driving force (the elastic restoring force of the pull spring 22) and the acting structure thereof (the first link 23) to generate a moment, so that the first link 23 is moved to drive the operating mechanism 2 to move integrally.

[0050] In the design of the operating mechanism 2 in the embodiment, when opening and closing, the limiting raised portion 325 on the wheel 32 and the base 1 perform position-limiting, so that the swing range of the movable contact 31 is also limited by the limiting groove, to prevent the movement amount of the movable contact 31 from being too large, avoid the intense collision between the movable contact 31 and the stationary contact or other components, reduce the overshoot generated while opening and closing, and improve the mechanical characteristics. And when the limiting raised portion 325 on the wheel 32 and the base 1 performs position-limiting, the impact reaction force generated acts on the first link 23 and the second link 24, at this time, the first link 23, the second link 24 and the pull spring 22 form a buffer device to absorb the impact energy, thereby reducing the mechanical impact on the mechanism when opening and closing, improving the mechanical strength, reducing the impact on the tripping piece 25 and the releasing half shaft 41, and improving the locking performance. On this basis, a spring 17 may further be disposed inside the

wheel 32, as shown in any one of Figs. 42-46, an end of the spring 17 is fixed on the movable contact 31, and another end is fixed in the wheel 32, and the spring 17 may similarly absorb and buffer the movement of the movable contact 31.

[0051] When serious overload or short circuit or under-voltage occurs in the circuit, the circuit breaker needs to be able to quickly cut off the circuit, so as not to burn the components under excessive current, therefore, the circuit breaker normally has a quick releasing mechanism to quickly break the circuit, and the speed of releasing directly affects the ability of the circuit breaker to cut off the fault current. In this regard, when the circuit breaker in the embodiment is performing electrical protection, according to the size of the overcurrent, there are two releasing modes: thermal-magnetic releasing and repulsion releasing. The thermal-magnetic releasing mode is realized by the first releasing combination composed of the release 5 and the locking mechanism 4. When the small ampere current (as in the embodiment, it is 2.5kA in a specific typical application) is over-current, it will work by thermal-magnetic releasing mode. When a larger ampere current (as the present embodiment is 10kA in a specific typical application) is over-current, the repulsion releasing mode mainly works, and the releasing speed of the repulsion releasing is faster and the breaking capacity is stronger. The repulsion releasing mode is mainly realized by the second releasing combination composed of the movable contact 31, the locking mechanism 4 and a releasing link mechanism. The locking mechanism 4 includes a releasing half shaft 41 and a tripping piece 25 which may be lapped on the releasing half shaft 41, and the releasing half shaft 41 and the tripping piece 25 may be rotatably connected to the circuit breaker housing.

[0052] Referring to Figs. 49-50, the releasing half shaft 41 includes an approximately cylindrical shape base body portion 413 which has a first protruding post 417 and a second protruding post 414 at front and rear ends thereof for rotatably mating with the base plate 8. The base body portion 413 has a fan-shaped plate 415 generally extending outward along a radial direction thereof, and the fan-shaped plate 415 has a third protruding post 4152 extending rearward along an axial direction of the base body portion 413 at a free end thereof. The fan-shaped plate 415 and the third protruding post 4152 form an extension portion that is not coaxial with the base body portion 413 and extends along an axial direction of the releasing half-shaft 41 in an approximately "L" shape. The fan-shaped plate 415 further has a raised limiting portion 4151. A collar 416 is sleeved and fixed on the base body portion 413. The collar 416 and the base body portion 413 have a groove approximately along the tangential direction of the base body portion 413 at a same position on a side surface. The depth of the groove on the collar 416 at least at an end close to the upper end thereof is larger than the depth of the groove on the base body portion 413 at least at an end close the upper end thereof, so that when the collar 416 is sleeved on the

base body portion 413, the collar 416 and the base body portion 413 form the step 411 and the groove 412 engaged together at the groove. The groove 412 is a through groove that approximately runs through from top to bottom, and the lapped portion 253 of the tripping piece 25 may be lapped on the step 411. When the releasing half shaft 41 rotates counterclockwise, the lapped portion 253 of the tripping piece 25 may break away from lapping of the step 411 and fall from the groove 412. The collar 416 has a first paddle 4161 and a second paddle 4162 extending outwards approximately along a radial direction thereof. A free end of the second paddle 4162 is in a "J" hook-shape. Since it is required to provide the groove 412, the second paddle 4162 has a gap approximately equivalent to the groove 412 in width at the position corresponding to the groove 412. The gap and the groove 412 form a space for the lapped portion 253 of the tripping piece 25 to fall. In the front-rear direction, the fan-shaped plate 415, the first paddle 4161 and the second paddle 4162 are approximately separated in a "Y" shape. In the embodiment, the collar 416 is sleeved on the base body portion 413 to form the step 411 and the groove 412 on the releasing half shaft 41, which is more convenient for production and installation. In other embodiments, the releasing half shaft 41 may also be integrally formed.

[0053] Referring to Fig. 48, the releasing half shaft 41 is rotatably mated on the through hole 8"2 on the second base plate 8" with the second protruding post 414 thereof. The third protruding post 4152 of the releasing half shaft 41 may fall into the fan-shaped groove 8"3 on the second base plate 8" at the same time. The rotation range of the releasing half shaft 41 is limited by the fan-shaped groove 8"3. On the one hand, it prevents the position deviation of the releasing half shaft 41 under the action of a torsion spring 14, and on the other hand, it may limit the rotation angle of the releasing half shaft 41 to match the design of the assembly position of the step 411 and the groove 412 with the lapped portion 253. The torsion spring 14 is arranged on the left side of fan-shaped groove 8"3, and the torsion spring 14 is wound on the protruding fixing seat 8"4 on the second base plate 8", and a first arm 141 of the torsion spring 14 is blocked by a stopper 8"5 to limit from twisting. When the releasing half shaft 41 is assembled on the second base plate 8", the second arm 142 of the torsion spring 14 acts against the third protruding post 4152 of the fan-shaped plate 415 of the releasing half shaft 41. The torsion spring 14 is limited in the front-rear direction by the limiting portion 4151 and the second base plate 8". The fan-shaped plate 415 is always given a restoring force approximately toward a right side, so that the releasing half shaft 41 always has a clockwise rotation trend. On one hand, the tripping piece 25 may be in the state of being lapped with the step 411 (that is, in the locking state), so that the step 411 on the releasing half shaft 41 leans against the tripping piece 25 to the right to form a stable locking; on the other hand, the tripping piece 25 may be manually opened and reset

after releasing (step V in the movement principle of the operating mechanism 2 and the contact system 3), when the rising height of the tripping piece 25 is higher than the step 411, the trip half shaft 41 is pushed to rotate clockwise to enable the step 411 to re-lap the tripping piece 25, thereby helping the releasing half shaft 41 to reset. In the embodiment, a fan-shaped groove is formed on the circuit breaker housing to cooperate with the releasing half shaft to form a limiting mechanism, which is convenient for manufacturing and production, and improves the compactness of the structure. In the embodiment, the torsion spring 14 is used as a resetting member of the releasing half shaft, which is convenient for installation and relatively low in cost. In other embodiments, structures such as column springs may also be used, as long as the above-mentioned structural functions can be satisfied.

[0054] Referring to Fig. 51, the releasing link mechanism includes an approximately "c"-shaped traction element 42. The traction element 42 includes a cylindrical shape base body portion 421 for being rotatably connected to the circuit breaker housing. The outer peripheral side of the base body portion 421 is connected with a protruding portion 423 extending approximately radially outward (as a fitting portion where the traction element 42 and the third link 33 lean against and fit with each other) and a flat plate 424, and a pushing portion 422 (as a driving portion acting where the traction element 42 and the releasing half shaft 41 lean against and fit with each other) is connected to the outer peripheral side of the base body portion 421. When the traction element 42 rotates, the pushing portion 422 may lean against the second paddle 4162 so as to transmit force to the releasing half shaft 41 to make the releasing half shaft 41 rotate. Therefore, the pushing portion 422 is provided with a yielding groove matching the cut-off portion of the second paddle 4162, so as to make way for the fall of the tripping piece 25. Moreover, the pushing portion 422 is a hook-shaped structure, and a tail end of the pushing portion 422 extending approximately transversely acts as a force applying point for shifting the driving force of the second paddle 4162, so as to improve the mechanical property of the pushing portion 422 as the force applying structure. The second paddle 4162 is also hook-shaped, and the tail end of the pushing portion 422 can lean against the inner side of the hook structure of the second paddle 4162, so that the leaning and fitting therebetween is more tight. Referring back to Fig. 48, the traction element 42 is rotatably connected to the second base 1", and in the closing state, the pushing portion 422 leans against the second paddle 4162, so as to shorten the process of movement therebetween, and improve linkage efficiency.

[0055] The releasing link mechanism further includes a third link 33, referring back to Fig. 10, the third link 33 is rotatably connected to the inside of the wheel 32 by a pin connection, and the third link 33 is approximately in a "d" shape and has a protrusion structure projecting ra-

dially outward of the wheel 32. Referring to Figs. 52-54, the lower end of the third link 33 rotatably connected to the wheel 32 (as a first fitting portion where the third link 33 and the movable contact 31 lean against and fit with each other) and the upper end of the movable contact 31 are disposed close to each other, and have certain sliding fitting surfaces respectively, and the sliding fitting surfaces thereof are designed to meet the following force requirements: When the movable contact 31 rotates clockwise, the sliding fitting surface at the upper end of the movable contact 31 can apply a force to the sliding fitting surface at the lower end of the third link 33 to make the third link 33 also rotate clockwise, so that the radially outer side of the third link 33 (as a second fitting portion where the third link 33 and the traction element lean against and fit with) protrudes toward the outer periphery of the wheel 32. The lower end of the third link 33 is approximately a downward protruding structure with a smooth arc surface. On one hand, the downward protruding structure may reduce the stress area of the third link 33 and concentrate the force. On the other hand, the design of smooth arc surface may make the movable contact 31 apply force to the third link 33 more stably. The upper end of the movable contact 31 is approximately an involute arc surface outward from a joint C, so that the upper end of the movable contact 31 applies force to the third link 33 more stably. Moreover, the design of the involute arc surface may expand the surface of the movable contact 31 that may move and apply force, and increase the reliability of the linkage between the movable contact 31 and the third link 33. Therefore, when the movable contact 31 rotates clockwise around the joint C thereof with the wheel 32, the upper end of the movable contact 31 leans against the lower end of the third link 33, and makes the third link 33 rotate clockwise around the joint D thereof with the wheel 32 so as to expose the wheel 32. The stress diagram is shown in Fig. 55. It can be seen that the force F4 of the movable contact 31 on the third link 33 is at the left side of the rotation center point of the third link 33, thereby generating a moment to make the third link 33 rotate clockwise. Moreover, a rotation center D of the third link 33 is disposed at the tail end away from the movable contact 31 to increase the moment arm of the rotating force when the third link 33 is pushed by the movable contact. Both the third link 33 and the movable contact 31 are rotatably connected to the wheel 32, and mutual interference may be avoided under the dynamic movement of the circuit breaker. It should be noted that the design of the sliding fitting surface between the lower end of the third link 33 and the upper end of the movable contact 31 is related to the movement position and external shape of the two, and corresponding design is required in different implementation applications, so as to make it meet the stress requirements above.

[0056] Referring to Figs. 52-54 in sequence, and in combination with the above structural features, a repulsion releasing principle in this embodiment is presented

as follows: when an expected short-circuit current occurs in the circuit, the movable contact 31 is repelled by the Horn force and the Lorentz magnetic force, and the upper end of the movable contact 31 pushes the third link 33 to rotate clockwise. When the third link 33 is exposed out of the wheel 32, the projected outer side of the third link 33 collides with the projected part 423 of the traction element 42 in the rotation process of the third link 33, to push the traction element 42 to rotate clockwise. Meanwhile, due to that the movable contact 31 is repelled to disengage with the stationary contact, there is an electric arc generated between the movable contact 31 and the stationary contact, the pressure in the arc extinguishing chamber rises, and the high-pressure gas will move upward to push the flat plate 424 (therefore, it is preferable that the flat plate 424 is a plate-like structure with a plane facing to the direction of the arc extinguishing system 6). Furthermore, the traction element 42 is pushed to rotate clockwise. During the clockwise rotation of the traction element 42, the pushing portion 422 collides with the second paddle 4162, and finally pushing the releasing half shaft 41 to rotate counterclockwise, to release the releasing half shaft from the tripper. So that the switch trips to cut off the fault circuit.

[0057] Next, when the tripping piece 25 after being unlocked is manually reset, it can be known from the part of the torsion spring 14 that the torsion spring 14 may drive the clockwise rotation of the releasing half shaft 41 to be reset, and in this process, the second paddle 4162 collides with the pushing part 422 to push the counterclockwise rotation of the traction element 42 to be reset. The third link 33 has a torsion spring structure disposed at its rotation point to reset the third link 33. Similarly, the traction element 42 may also have a reset torsion spring, but it is not necessary to provide the reset torsion spring for the traction element 42 under the action mechanism of the second paddle 4162.

[0058] In this embodiment, it is illustrated as an example that a compact and efficient two-link mechanism consisting of the third link 33 and the traction element 42 serves to convert the movement trajectory of a sliding fitting surface at the upper end of the movable contact 31 into a driving force capable of flicking the second paddle 4162 on the releasing half shaft 41, to rotate the releasing half shaft 41 and move the locking mechanism to the unlocking position. However, in the application of other embodiments, it is possible to redesign other releasing link mechanism according to specific situations; all the technical solutions are feasible as long as the requirement of "converting the movement trajectory of the sliding fitting surface of the movable contact into the driving force capable of flicking the releasing half shaft" can be met.

[0059] In addition, it is worth explaining that in this embodiment, a simple and effective operating mechanism 2 is disposed on the right side of the wheel 32 to drive the rotation of the wheel 32. The third link 33 and the traction element 42 (as a releasing link mechanism) are

disposed in the space on the left side of the wheel 32 to trigger the locking mechanism 4 on the upper left side of the wheel 32 to realize repulsion release. Sufficient use of the whole space of the circuit breaker can facilitate reducing the overall size of the circuit breaker and ensure the reliability of linkage among mechanisms.

[0060] The repulsion releasing mode in this embodiment permits to repel the contacts quickly by using the Horn force and the Lorentz magnetic force generated by the short-circuit current, and directly unlock the releasing half shaft 41 and the tripping piece 25 through the link transmission (with the help of the movement cooperation of the third link 33, the traction element 42 and the second paddle 4162), to shorten the response time of the mechanism, improve the ability of cutting off the fault current, and reduce the impact of the fault current on the system. Moreover, the direct releasing mode of the link transmission can prevent the contacts from being closed with the static contact after being repelled, prevent the electric arc from reigniting, reduce the burning loss of the contacts, and reduce the electric arc extinguishing difficulty.

[0061] As mentioned above, a thermo-magnetic releasing mode is further provided in this embodiment and is realized by a first releasing combination formed by the release 5 and the locking mechanism 4. Referring to Fig. 56, the release 5 is a thermo-magnetic release, when short-circuit occurs in the circuit, a yoke on release 5 is magnetized, to attract the action of the armature 51, so that the armature 51 strikes the first paddle 4161, so as to rotate the releasing half shaft 41 counterclockwise, unlock the switch by the tripping piece 25, and cut off the fault circuit.

[0062] In addition, in this embodiment, the first paddle 4161 and the second paddle 4162 on the releasing half shaft 41 serve as triggers rotating the releasing half shaft 41. After being triggered (for example the striking action of release 5 and the pushing action of the second connecting rod 42), the trigger rotates the releasing half shaft 41 to achieve the releasing purpose. In other applications, the trigger may be designed adaptively according to the actual situations to serve as the receiving portion of the driving force finally formed under the repulsion releasing mode or the thermo-magnetic releasing mode, and after receiving the trigger, the locking mechanism is actuated to complete the unlocking, which may be the flicking and rotating in this embodiment or other ways such as moving and unlocking, etc. The design of its movement is based on the repulsion releasing mode provided in this embodiment, and the similar "repulsion trigger releasing" solution generated by combination of various existing locking mechanisms should be considered to be within the technical ideas provided by the present invention.

[0063] In addition, it should be noted that in the multi-pole circuit breaker module (Fig. 7), the circuit breaker module of each pole has the release 5, and the releasing half shaft 41 penetrates all of the multi-pole circuit breaker modules. If the circuit breaker module of each pole shares

one releasing half shaft 41, the releasing half shaft 41 of the circuit breaker module of each pole rotates synchronously. Referring to Fig. 57, there is a second paddle 4162 (4162') on the releasing half shaft 41 of the circuit breaker module of each pole (in the circuit breaker module without the operating mechanism 2, it is unnecessary to provide a groove on the releasing half shaft 41 to provide an accommodation space for the tripping piece 25, so that the first paddle may not be cut to form the groove. In Fig. 57, the first paddle in the circuit breaker module without the operating mechanism 2 is denoted by a reference number 4162'), when the short-circuit occurs in the circuit breaker module of any pole, the repulsion releasing mechanism of the circuit breaker of this pole repels the contacts quickly by using the Horn force and the Loren magnetic force generated by the short-circuit current, so that the releasing half shaft 41 of the whole multi-pole circuit breaker module rotates synchronously. Therefore, the circuit breaker module with the operating mechanism 2 are unlocked and switch to be tripped, and then the contact systems 3 of the circuit breaker modules move synchronously, and the fault current is cut off. Similarly, there is a first paddle 4161 on the releasing half shaft 41 of the circuit breaker module of each pole, so that the release 5 hits and controls the tripping piece 25 to be unlocked and switch to be tripped.

[0064] In addition, it is required to cut off the circuit quickly, to avoid burning the components under excessive current. Therefore, the circuit breaker usually has a quick releasing mechanism to interrupt the circuit quickly, and the releasing speed directly affects the capability of the circuit breaker cutting off the fault current.

[0065] Therefore, the present disclosure also provides a circuit breaker with quick releasing, including a locking mechanism and a contact system. The contact system includes movable contacts which are rotatably connected. The circuit breaker further includes a releasing link mechanism. The movable contact includes a movable contact surface at one end of the rotation point and a fitting surface at the other end of the rotation point. The movable contact, the releasing link mechanism and the locking mechanism form a releasing combination. The locking mechanism has a trigger, and when the movable contact is forced to rotate, the fitting surface can drive the movement of the releasing link mechanism. The movement of the releasing link mechanism can trigger the trigger of the locking mechanism, so that the locking mechanism moves from the locking position to the unlocking position.

[0066] In order to improve an unlocking efficiency, in one embodiment, the locking mechanism at least includes a releasing half shaft and a tripping piece lapped thereto, and the trigger is disposed on the releasing half shaft. The releasing link mechanism is disposed in a rotatable manner, and when the movable contact rotates, the releasing link mechanism serves to convert the movement trajectory of the fitting surface into a driving force for flicking the trigger on the releasing half shaft, so that

the releasing half shaft rotates and the locking mechanism moves to the unlocking position.

[0067] In order to utilize the repulsive force of the movable contact to realize quick unlocking, for consideration of the compactness and reliability of the structure, in one embodiment, the releasing link mechanism includes a third link and a traction element. The third link includes a first fitting portion and a second fitting portion, and the traction element includes a third fitting portion and a driving portion. The first fitting portion of the third link is disposed close to the fitting surface, and the second fitting portion of the third link is matched with the third fitting portion of the traction element. The driving portion is matched with the trigger, and when the movable contact rotates, the fitting surface of the movable contact can be converted into a pushing force against the third link by matching with the first fitting portion. Therefore, the third link rotates toward the traction element, and when the third link rotates toward the traction element, it can be converted into a rotating force for the traction element through the cooperation of the second fitting portion and the third fitting portion, so that the driving portion has a driving force capable of flicking the trigger.

[0068] In order to avoid mutual interference under the dynamic movement of the circuit breaker, in one embodiment, both the third link and the movable contact are rotatably connected to the same movable part (that is, the wheel in the embodiment).

[0069] In order to improve the stability of stress and force application of the third link, in one embodiment, the third link is a block structure approximately in a "d" shape, including a second projection forming a d-shaped main body, a first projection protruding toward the fitting surface, and a tip far away from the two. The tip is pivotally disposed, the first projection serves as the first fitting portion, and the second projection serves as the second fitting portion.

[0070] In order to improve the mechanical properties, prolong the service life of parts, and improve the stability of stressed movement, in one embodiment, the traction element is a block structure approximately in a "C" shape, including a base body portion pivotally disposed, a raised first projection extending to the outside of the base body portion as a third fitting portion, and a driving portion extending to the outside of the base body portion. The first projection abuts against the second fitting portion of the third link, the driving portion is in a hook-shaped structure, and the tip of the driving portion serves as an application point of the driving force for flicking the trigger.

[0071] In order to improve the unlocking efficiency, gas discharge of the arc extinguishing chamber is utilized. In one embodiment, the arc extinguishing system is also included, and the traction element also has a second projection protruding to the outside of the base body portion, and the second projection is a flat plate structure with a plane facing the direction of the arc extinguishing system.

[0072] Wherein, on the basis of mounting and manu-

facturing consideration, in one embodiment, the releasing half shaft has an approximately column-like base body portion; a first groove is tangentially provided along an outer circle of the base body portion, and has a stepped structure engaged with the groove on one end of the first groove; both the releasing half shaft and the tripping piece are rotatably disposed; one end of the tripping piece may be lapped on the stepped structure; when the releasing half shaft rotates, one end of the tripping piece is disengaged from the stepped structure and falls into the first groove; the tripping piece is a sheet-like structure, one end of which has a curved hook-like lapped portion, and the lapped portion of the tripping piece is lapped on the stepped structure.

[0073] On the basis of mounting and manufacturing consideration, in one embodiment, the releasing half shaft further comprises a collar which is sleeved on the base body portion, and a second groove is provided tangentially on an outer periphery of the collar. When the collar is sleeved on the base body portion, the second groove and the outer circle surface of the base body portion form the stepped structure.

[0074] In order to make way for the tripping piece, in one embodiment, the trigger is a flat-plate paddle structure and has a notch approximately equal to a width of the first groove, and the notch and the first groove together form an abdication space into which the tripping piece falls.

[0075] In order to reset the locking mechanism and limit a reasonable rotation position of the locking mechanism, in one embodiment, the locking mechanism further includes a limiting mechanism for limiting a rotation angular range of the releasing half shaft and a resetting member for applying a restoring force of the movement from the unlocking position to the locking position to the releasing half shaft.

[0076] On the basis of manufacturing and installing consideration, in one embodiment, the circuit breaker has a circuit breaker housing, and the circuit breaker housing has a fan-shaped groove; the releasing half shaft is provided with an extension portion approximately in a "L" shape which is not coaxial and extends along an axial direction of the releasing half shaft; the releasing half shaft is rotatably assembled on the circuit breaker housing; and when the releasing half shaft is assembled on the circuit breaker housing, the first extension portion is inserted into the fan-shaped groove, thereby realizing the limiting mechanism.

[0077] On the basis of cost and installation consideration, in one embodiment, the resetting member is a torsion spring, and one arm of the torsion spring abuts against the extension portion.

[0078] In order to ensure multiple unlocking functions, in one embodiment, in light of the improved design of the above structure, in addition to the space in which the second releasing combination of the second releasing modes, the circuit breaker further includes a thermomagnetic release, and the second releasing combination in-

cludes the thermomagnetic release and the locking mechanism. The locking mechanism is also provided with a second trigger, and the thermomagnetic release generates a driving force for the second trigger after being magnetically excited and/or thermally deformed, thereby triggering the second trigger of the locking mechanism and moving the locking mechanism from the locking position to the unlocking position.

[0079] The circuit breaker with quick releasing function has following beneficial effects: the contacts are quickly repelled by using the Horn force and the Lorentz magnetic force generated by the short-circuit current, and the releasing half shaft and tripping piece are directly unlocked by the releasing combined transmission. This can shorten the response time of the mechanism, improve the capability of cutting off the fault current, and reduce an impact of the fault current on the system. The use of the link transmission direct releasing mode can avoid the contacts from being closed with static contacts after being repelled, to prevent re-ignition of the electric arc, reduce the burning loss of the contacts, and reduce electric arc extinguishing difficulty.

[0080] Furthermore, when the circuit breaker performs interruption, an initial distance between the movable contact and the stationary contact is small, but an electric field intensity is high, it is resulted in that an electric arc may be generated between the movable contact and the stationary contact. If the electric arc is not extinguished, the circuit cannot be completely disconnected, and the electric arc has a very high temperature, and the high-temperature electric arc may burn out the equipment, to cause serious accidents. Therefore, it is one of the important functions of the circuit breaker to quickly and effectively extinguish the electric arc generated when circuit breaker performs the interruption.

[0081] It is the conventional arc extinguishing means to use an arc extinguishing grid at present, that is, under the action of magnetic field and gas pressure, the electric arc moves to the arc extinguishing grid, and the electric arc is cut by the arc extinguishing grid, so that a voltage of the electric arc rises until it exceeds a power supply voltage of the system, and the electric arc is extinguished. However, in the prior art, several problems in the following are still presented.

1. In the arc extinguishing process, one end of the electric arc has been burning on the movable contact, and the contact is seriously ablated under the action of the electric arc, which can affect the service life of the electrical appliances.
2. In the arc extinguishing process, it is difficult for the arc to access into all the grids, which can affect the arc extinguishing performance.
3. At an initial stage of opening the movable and stationary contacts, the electric arc runs slowly, and the electric arc can only be cut by few of the grids, so that it is difficult to raise the voltage of the electric arc within a short time, and current limiting ability is

limited.

[0082] Therefore, the present disclosure further provides a circuit breaker with good arc extinguishing effect.

[0083] The circuit breaker with good arc extinguishing effect includes a contact system. The contact system includes a movable contact and a stationary contact, characterized in that magnetism increasing components are disposed around the movable contact; the magnetism increasing components enclose to form a magnetism increasing space approximately surrounding the stationary contact and the movable contact.

[0084] On the basis of cost and installation consideration, in one embodiment, an movement of the movable contact with respect to the stationary contact is constructed to present the movement trajectory of the conduction or interruption, the magnetism increasing components comprises two oppositely disposed first magnetism increasing blocks disposed on both sides of the movement trajectory of the movable contact, and a second magnetism increasing block and a third magnetism increasing block respectively disposed on both ends of the movement trajectory of the movable contact.

[0085] In order to form a magnetism increasing space for surrounding the stationary contact and the movable contact, in one embodiment, a first U-shaped groove is provided on the second magnetism increasing block, two oppositely disposed first magnetisms increasing blocks and the third magnetism increasing block are connected to form a second U-shaped groove, so that the first U-shaped groove and the second U-shaped groove enclose to form the magnetism increasing space.

[0086] In order to improve the arc extinguishing efficiency, in one embodiment, an arc extinguishing system is further included. The arc extinguishing system includes a first running arc channel relatively close to the movable contact, a second running arc channel relatively close to the stationary contact, an arc extinguishing chamber, and an arc extinguishing grid set disposed within the arc extinguishing chamber. The first running arc channel and the movable contact are equipotentially connected, and the second running arc channel and the stationary contact are equipotentially connected, and the first running arc channel is disposed close to a side of the movable contact.

[0087] In order to improve the electric arc running length and stretch the electric arc to fully extinguish the arc, in one embodiment, the first running arc channel and the second running arc channel extend approximately along an arrangement direction of the arc extinguishing chamber and terminate on both ends of the arc extinguishing chamber.

[0088] In order to improve the arc extinguishing effect and increase arrangement number of the arc extinguishing grids, in one embodiment, the arc extinguishing grid set consists of a plurality of arc extinguishing grids arranged in an arc and linear shape, and the length of the arc extinguishing grid set is approximately equal to the

length of the arc extinguishing chamber.

[0089] In order to move the movable contact relatively close to the first running arc channel and guide the electric arc to the first running arc channel quickly, in one embodiment, one end of the first running arc channel relatively close to the movable contact is a hook-like extended structure approximately toward the first running arc channel.

[0090] On the basis of installation and connection position consideration, in one embodiment, the first running arc channel comprises a base body portion extended linearly, a first end of the base body portion is close to the movable contact, the first end of the base body portion is connected to an engaged portion extended bendably, one end of the engaged portion and the movable contact are equipotentially connected, the engaged portion and the base body portion form an approximately semi-enclosed installation space, the second magnetism increasing block is mounted in the installation space.

[0091] In order to move the movable contact relatively close to the first running arc channel and guide the electric arc to the first running arc channel quickly, in one embodiment, the engaged portion and the movable contact are staggered.

[0092] On the basis of installation and connection position consideration, in one embodiment, the second running arc channel is welded to the stationary contact, the second running arc channel and the stationary contact form an approximately semi-enclosed installation space, the third magnetism increasing block is mounted in the installation space.

[0093] On the basis of installing and manufacturing consideration, in one embodiment, two ends of the third magnetism increasing block in a width direction are exposed out of the installation space, the first magnetism increasing blocks are contacted and connected with two ends of the third magnetism increasing block in the width direction, to form the second U-shaped groove.

[0094] The circuit breaker with the good arc extinguishing effect has following beneficial effects: the design of the arc extinguishing system of the present disclosure can maximize the length of the arc extinguishing chamber and the number of the arc extinguishing grids, that is, the length and the size of the circuit breaker housing are fully utilized, and also the magnetism increasing components are provided such that the arc extinguishing efficiency can be improved, and the electric arc is fully extinguished by the arc extinguishing grids. At the same time, when the movable contact is just repelled, the electric arc may trip from the movable contact to the arc running channel, to prevent the movable contact from being continuously ablated and avoid affecting the service life of the electrical appliances.

[0095] In addition, the design of the arc extinguishing grids is one of key points of the circuit breaker arc extinguishing system. In order to achieve great arc extinguishing effect, it is generally expected to have a large area of the arc extinguishing grid; however the circuit breaker

generally has width specifications, so that under the limitation of the standard width and size of the circuit breaker, it is expected to make the size of the arc extinguishing grid higher, the length of the arc extinguishing grid set longer or the gap between the arc extinguishing grids smaller in the design process of the arc extinguishing system. However, the high height of the arc extinguishing grid means that the electric arc stays in the arc extinguishing grid for a long time. The arc extinguishing grid absorbs too much arc energy to result in serious burning loss of the arc extinguishing grid. Therefore, it is one of the problems to be concerned by the person skilled in the art how to allow the electric arc to pass through the arc extinguishing grid quickly to implement the arc extinguish under the premise of ensuring the height of the arc extinguishing grids.

[0096] When the circuit breaker generates an electric arc, a large amount of gas is generally produced. A Chinese patent with publication number (CN205282331U) provides a low-voltage circuit breaker contact arc extinguishing system. Wherein a channel structure in which an arc channel formed by an arc partition plate and an arc extinguishing grid is gradually narrowed and contracted, and then gradually widened and expanded (that is, the Laval nozzle) is selected to accelerate the gas flow. With its structure, the electric arc is pushed by the gas to quickly pass through the arc extinguishing grid to be cooled and elongated. However, in this solution, the arc partition plate is installed on the side of the arc extinguishing grid set close to the movable contact system, and the arc extinguishing grid itself needs to be designed with an opening to form an airflow expansion area, due to which the design of the arc extinguishing grid is limited. Moreover, because the arc partition plate is installed on the side of the arc extinguishing grid set close to the movable contact system, the Laval nozzle structure is too close to the movable contact system, so that the front section of the gas channel from "the movable contact-the arc extinguishing grid" is curved. After actual test, at an initial stage of the electric arc generation, the gas generated by the circuit breaker is less and the gas velocity is not fast, the gas is prone to turbulence when passing through the connecting area between the arc partition plate and the arc extinguishing grid. This is not conducive to the stable discharge of the gas flow and the rapid pushing of the electric arc through the arc extinguishing grid.

[0097] Therefore, the present disclosure also provides an arc extinguishing system with fast gas blowing arc extinguishing effect and a breaker having the arc extinguishing system.

[0098] The arc extinguishing system includes an arc extinguishing grid set formed by a plurality of separate arc extinguishing grids arranged at intervals. The circuit breaker further comprises a gas pressure-raising channel disposed outside the arc extinguishing grid set, it is defined that a side facing to the gas pressure-raising channel is an upper side, a side facing to the arc extinguishing grid set is a lower side, and further comprises

at least one pair of guide members disposed in pair, at least one set of projected parts that are oppositely disposed and projected to each other is provided on respective opposite sides of each pair of the guide members, there is a grid gap between two adjacent arc extinguishing grids in the arc extinguishing grid set, the projected parts is entirely inserted into a position close to the lower end of the grid gap, a Laval nozzle channel is formed by at least one set of projected parts and two adjacent arc extinguishing grids, the gas pressure-raising channel is a structure with an opening having a diameter gradually expanded toward the arc extinguishing grid set and in communication with the Laval nozzle channel, so that gas generated by the arc extinguishing system is pressurized by the gas pressure-raising channel located on the upper side, and then is discharged from the Laval nozzle channel located on the lower side.

[0099] On the basis of manufacturing and installing consideration, and also in order to improve airtightness of the gas channel, in one embodiment, the guide members are approximately in a strip-sheet shaped structure, each pair of the guide members facing to each other are inserted into the grid gap, so that the projected parts are interposed in the grip gap to substantially fill and enclose the gaps on both sides of the grip gap.

[0100] In order to facilitate installing the guide members, in one embodiment, there is a plurality of guide members, all of the guide members are spaced apart from one another and upper ends of the guide members are fixedly connected to the same first connecting part to form an integrated comb-like structure, all of the guide members are integrally inserted into the grid gap of the arc extinguishing grid set by the integrated comb-like structure.

[0101] In order to improve the flexibility of installing the guide members, in one embodiment, there is the plurality of guide members, every two of the guide members are spaced apart in parallel and side ends of the two guide members are fixedly connected to a second connecting part to form a U-shaped plate structure, so that the guide members are respectively inserted into the grip gap from both sides of the arc extinguishing grid set by a plurality of U-shaped plate structures in pair.

[0102] As a convenient installation solution, in one embodiment, the plurality of U-shaped plate structures are inserted one by one or inserted by separating one of the arc extinguishing grids therebetween.

[0103] In order to use the gas generated by the electric arc when being interrupted and to protect the movable contact, in one embodiment, the gas pressure-raising channel is disposed in a manner of covering the movement trajectory of the movable contact of the contact system.

[0104] On the basis of installing and manufacturing consideration, in one embodiment, a first partition plate and a second partition plate oppositely disposed on both sides of the movement trajectory of the movable contact of the contact system are respectively disposed outside

the arc extinguishing grid set, the first partition plate and the second partition plate have a first raised portion and a second raised portion extending and projecting to each other on the respective opposite sides thereof, respectively; the first partition plate and the second partition plate further have a first slope and a second slope engaged with the first raised portion and the second raised portion on the respective opposite sides of the first partition plate and the second partition plate, the first slope and the second slope oppositely disposed are combined to form the gas pressure-raising channel gradually expanded approximately toward the arc extinguishing grid set.

[0105] In order to rapidly exhaust free gas generated in arc extinguishing system, in one embodiment, the circuit breaker further comprises a distributor approximately disposed on a lower side of a discharge port of the Laval nozzle channel, the distributor comprises a pointed cone structure formed by docking two inclined surfaces, wherein the inclined surface is inclined to the Laval nozzle channel, to guide the gas discharged via the Laval nozzle channel toward two directions away from each other along a length direction of the arc extinguishing grid set.

[0106] In order to make exhaust velocity on both sides as close as possible and improve the exhaust efficiency, the distributor is disposed at a middle position in a length of the arc extinguishing grid set.

[0107] In order to reduce the stagnation time of the air flow, in one embodiment, the distributor is disposed at a position directly facing to a contact position of the movable contact and the stationary contact of the contact system.

[0108] In order to improve the arc extinguishing efficiency by further gas production through the ablative effect of the electric arc, in one embodiment, the guide members are made of insulating gas-generated materials.

[0109] On the basis of the above arc extinguishing system, the present disclosure further provides a breaker that includes a contact system and an arc extinguishing system. And the arc extinguishing system is the arc extinguishing system mentioned above.

[0110] As a conventional application structure, in one embodiment, the breaker is a circuit breaker.

[0111] The arc extinguishing system with the fast gas blowing arc extinguishing grid effect and the breaker having the arc extinguishing system have following beneficial effects: the gas pressure-raising channel is provided outside the arc extinguishing grid, and the Laval nozzle channel is disposed in the gap among arc extinguishing grids, in this way, a coherent airway from "the movable contact-the arc extinguishing grid" is formed, so that the gas generated during the interruption of the circuit breaker can be accelerated in the whole process, and there is no turbulence phenomenon. The installation space in the arc extinguishing system is fully utilized to guide a large amount of gas generated during the interruption process, thereby enhancing the gas blowing effect and pushing

the electric arc to move quickly for quick arc extinguish. The Laval nozzle channel may be formed by using a single component, which cannot interfere with the shape design of the arc extinguishing grid. Under the joint action of the gas pressure-raising channel and the Laval nozzle channel, the gas can be discharged smoothly and the turbulence cannot be blocked, and the electric arc is pushed by the gas to extinguish the arc quickly through the arc extinguishing grids, so that the height of the arc extinguishing grid may be set high and the arc extinguishing effect can be improved.

[0112] Referring to Figs. 58-70, one embodiment of the circuit breaker of the present disclosure is shown. The circuit breaker includes a gas guide structure. The circuit breaker for quick gas blowing gas extinguish includes a circuit breaker housing inside which an installation cavity 7 is formed, and a contact system 3 and an arc extinguishing system installed within the circuit breaker housing. The arc extinguishing system includes an arc extinguishing chamber assembly 60 and a distributor 68 installed within the installation cavity 7. Referring to Fig. 59, the contact system 3 includes a movable contact 31 and a fixedly disposed stationary terminal 10. The movable contact 31 may move relatively close to or away from the stationary terminal 10 and has a movement path, so that the movable contact 31 can contact with or separate from the stationary terminal 10 by virtue of its movement to realize the conduction and interruption of the circuit breaker. Referring to Figs. 60-61, the arc extinguishing chamber assembly 60 includes an arc extinguishing grid set 63. The arc extinguishing grid set 63 is composed of a plurality of separate arc extinguishing grids arranged in a linear manner at intervals. The arc extinguishing chamber assembly 60 also includes two clamping plates 67 oppositely disposed on both sides of the arc extinguishing grid set 63 for mounting and fixing the arc extinguishing grids. And the arc extinguishing chamber assembly 60 further includes a first partition plate 69 and a second partition plate 69' with mirror images disposed opposite to each other, and each of the first partition plate 69 and the second partition plate 69' has a strip-shaped structure approximately identical to the extension direction of the arc extinguishing grid set 63. Referring to Fig. 60, Fig. 61, Fig. 63 and Fig. 64, if the first partition plate 69 and the second partition plate 69' are installed between the two clamping plates 67', and the movable contact 31 is located between the first partition plate 69 and the second partition plate 69', the first partition plate 69 and the second partition plate 69' and the arc extinguishing grid set 63 approximately enclose the movement path of the movable contact 31, in order to use the electric arc generated when being interrupted to burn the first partition plate 69 and the second partition plate 69' to generate gas, and a narrow gap 601 is remained respectively between the movable contact 31 and the first partition plate 69 and the second partition plate 69', to avoid movement scraping between the movable contact 31 and the first partition plate 69 or the sec-

ond partition plate 69'.

[0113] The first partition plate 69 and the second partition plate 69' are made of materials that are insulated and easy to generate gas, such as nylon, melamine, PA46, etc. When the circuit breaker occurs interruption, an electric arc is generated between the movable contact and the stationary contact. The first partition plate 69 and the second partition plate 69' can generate a large amount of gas when the electric arc is burned at the high-temperature. As shown in Figs. 64, 65 and 67, the first partition plate 69 and the second partition plate 69' have raised portions 692 extending and facing to each other on their respective opposite sides. On the two sides of the movable contact 31, the first partition plate 69 and the second partition plate 69' each has a slope 691 inclined to the movable contact 31 and engaged with the raised portion 692 and extending downward, so that the two sets of slopes 691 may form a gas pressure-raising channel which has a narrow upper portion and a wide lower portion and an opening gradually expands toward the arc extinguishing chamber assembly 60. For ease of description, it is defined as:

[0114] A side facing the gas pressure-raising channel is an upper side, and a side facing the arc extinguishing chamber assembly 60 is a lower side.

[0115] In this embodiment, the gas pressure-raising channel forms a straight and coherent gas channel between the movable contact and the arc extinguishing grid, to stably guide the gas to the arc extinguishing grid. And the gas pressure-raising channel can increase the pressure of the gas rapidly when the gas is passing through, so that when the movable contact and the stationary contact are separated, an electric arc may be generated, and the first partition plate 69 and the second partition plate 69' generate a large amount of gas at the high-temperature of the electric arc, on the one hand, the gas can block the narrow gap 601 to avoid overflowing the electric arc from the gap; on the other hand, under the action of the gas pressure-raising channel, the gas is rapidly pressurized to move toward the arc extinguishing grid set 63 in a direction of the lower end of the arc extinguishing chamber, and furthermore, the gas pushes the electric arc to quickly move toward the arc extinguishing grid set 63 and to be elongated, so as to quickly extinguish the electric arc and achieve the gas blowing arc extinguishing effect (an arrow in Fig. 64 represents a movement direction of the gas guided by the gas pressure-raising channel). After the test verification, a slope degree θ of the slope 691 is preferably 5° - 10° , in order to ensure the best air blowing effect on the basis of manufacture sizes of the first partition plate 69 and the second partition plate 69'.

[0116] In this embodiment, the gas is generated by using the first partition plate 69 and the second partition plate 69' and under the action of the electric arc combustion. The gas pressure-raising channel is formed by the structure of the first partition plate 69 and the second partition plate 69' to help guiding the gas flow and in-

crease the pressure of the gas flow for acceleration. Because of the coherent gas channel, even at the initial stage of the electric arc generation, the gas may not generate turbulence. And because the gas pressure-raising channel has a pressure-increasing effect, even if the arc extinguishing grid is designed to be high, the gas can be stably discharged from the arc extinguishing grid set. At the same time, the arc extinguishing chamber assembly 60 in this embodiment also has a Laval nozzle channel structure, the Laval nozzle channel structure is formed by guide members disposed in pairs on both sides of the arc extinguishing grid set 63. Referring to Fig. 65, in this embodiment, the guide members are insulating vertical plates 693 approximately having a strip-shaped structure. A plurality of insulating vertical plates 693 has upper ends fixedly connected to the first connecting part 694, so as to form an approximately integrated comb-like structure. The arrangement shape of the insulating vertical plates 693 is a downward convex arc the same (matched) as that of the arc extinguishing grid set 63, and the thickness and the adjacent gaps of the insulating vertical plates 693 are matched with the thickness and the adjacent gaps of the arc extinguishing grids, so that every two insulating vertical plates 693 in pairs can be inserted face to face between two adjacent arc extinguishing grids, and the gaps between the two adjacent arc extinguishing grids can be blocked approximately, thereby improving the airtightness and enhancing the flow-guiding effect. Entirely, as shown in Fig. 68, the insulating vertical plates 693 of the first partition plate 69 and the second partition plate 69' can be inserted into the arc extinguishing grid set 63 alternately, so that the first partition plate 69, the second partition plate 69' and the arc extinguishing grid set 63 are substantially embedded together, so that the insulating vertical plates 693 of the two opposite first partition plates 69 and second partition plates 69' are oppositely disposed in the gap of the arc extinguishing grid set 63. Therefore, every two adjacent arc extinguishing grids of the arc extinguishing grid set 63 and the insulating vertical plates 693 on both sides thereof form a plurality of gas channels arranged at intervals. All of the insulating vertical plates 693 can be integrally inserted into the gaps of the arc extinguishing grid set through the integrated comb-like structure. It is convenient for the integral installation of the arc extinguishing grid set 63, the first partition plate 69 and the second partition plate 69'. Referring to Fig. 65 and Fig. 67, projected parts 6931 projected toward each other in the arc shape are provided on the lower tip of each of pairs of the insulating vertical plates 693 opposite to each other, as observed from top to bottom (as can be seen, the gas moves from top to bottom under the action of the gas pressure-raising channel), the two projected parts 6931 opposite to each other form a contract channel with a diameter from large to small, and then form an expand channel with a diameter from small to large, that is, the gas channel has a diameter shrink in the middle and expand on the two ends, namely the Laval nozzle channel

602. The gas is accelerated under the action of the Laval nozzle channel 602 to further push the movement of the electric arc. At the same time, the Laval nozzle channel 602 with narrow opening structure can further compress the electric arc, improve the arc voltage, eliminate ionization and reduce arc re-ignition. In addition, in this embodiment, projected parts 6931 is in a U-shaped convex shape, and in other embodiments, may also be in a V-shaped shape, etc., it is feasible as long as the Laval nozzle channel has a waist in the middle in any shape from large to small and then from small to large.

[0117] In this embodiment, the projected parts 6931 and the arc extinguishing grid are staggered, and the projected parts 6931 are integrally inserted and disposed between the arc extinguishing grids. And the projected parts 6931 are disposed at the lower side between the arc extinguishing grids, so that the Laval nozzle channel 602 is formed in the space below the projected parts 6931 and the arc extinguishing chamber assembly 60. As above, the Laval nozzle channel can be formed by adopting a single component such as the insulating vertical plate 693, so that the structural design of the arc extinguishing grid is not limited to the insulating vertical plate 693. At the same time, a gas pressure-raising channel is designed on the side of the arc extinguishing grid facing the movable contact, to fit to the Laval nozzle channel 602, so that the gas is accelerated by the gas pressure-raising channel, and then accelerated by the Laval nozzle channel 602, the accelerated gas cannot happen turbulence phenomenon. Moreover, the gas pressure-raising channel is disposed on the upper side of the arc extinguishing grid, and the Laval nozzle channel 602 is disposed on the lower side between the gaps of the arc extinguishing grid, the gas channel from "the movable contact-the arc extinguishing grid" is coherent, the gas is stably accelerated in the whole process of the gas channel, and a great gas blowing effect can be achieved. The electric arc is pushed by the gas to be rapidly elongated and cooled and the dissipation is eliminated. Under the joint action of the gas pressure-raising channel and the Laval nozzle channel, the gas can be discharged smoothly, without turbulence blockage, and the electric arc can be pushed by the gas to be quickly extinguished through the arc extinguishing grids. Therefore, the arc extinguishing grid can be disposed high, which not only does not affect the arc extinguishing effect, but also can improve the arc extinguishing effect. At the same time, the guide members (insulating vertical plates 693) are made of the materials that can be insulated and generate gas and inserted into the gap among the arc extinguishing grids. During the movement of the electric arc, it can be cut by the arc extinguishing grid to extinguish arc, and at the same time, it can ablate guide members in the movement process to further generate gas. The gas flow generated by the guide members burned by the electric arc can promote the movement of the electric arc, so as to improve the arc extinguishing efficiency.

[0118] Referring to Fig. 58, after the electric arc is

deionized through the arc extinguishing chamber assembly 60, the gas is ejected from the lower portion of the arc extinguishing chamber assembly 60. In order to rapidly guide the gas flow to both sides of the installation cavity 7, in this embodiment, a distributor 68 is also disposed. Referring to Fig. 59 and Fig. 70, the distributor 68 has a tapered convex structure to form two gas flow guiding slopes 681 and 682 to the both sides of the installation cavity 7, so that the guiding slopes 681 and 682 can rapidly exhaust gas to the both sides to prevent that the hot gas flow gather at the lower portion of the arc extinguishing chamber assembly 60 to cause re-ignition or reflect the hot gas flow back to the contact area to lead to serious breakdown, and thus cause the failure of interruption. In this embodiment, the distributor 68 is disposed just below the closing position (contact position) of the movable and stationary contacts. When the movable and stationary contacts are just opened, gas is generated between the movable and stationary contacts, and the electric arc enters the arc extinguishing chamber assembly 60 to be deionized, and then the gas can be quickly discharged to both sides through the distributor 68, thereby reducing the gas flow stagnation time. In other embodiments, as shown in Fig. 69, the distributor 68 is also centrally disposed under the arc extinguishing chamber assembly 600. This can make the gas-exhaust speed on both sides as close as possible and improve the gas-exhausting efficiency.

[0119] In this embodiment, such structure as the gas pressure-raising channel and the Laval nozzle channel is provided. The sufficient use of the installation space can guide the circuit breaker to generate a large amount of gas in the interruption process, and guide the flow of the gas, so as to enhance the gas blowing effect and extinguish the arc quickly by pushing the movement of the electric arc.

[0120] In addition, it should be explained that, as shown in Fig. 58, in the layout of the circuit breaker, in this embodiment, the contact system 3 is disposed above the arc extinguishing chamber assembly 60. The arc extinguishing chamber assembly 60 extends along the length direction of the circuit breaker, so that the arc extinguishing chamber assembly 60 makes full use of the length of the circuit breaker. By increasing the number of the arc extinguishing grids, the arc running path may also be disposed longer, so as to draw the electric arc longer and further enhance the arc extinguishing effect. At the same time, since the arc extinguishing chamber assembly 60 is horizontally arranged along the length of the circuit breaker, the contact system 3 may be arranged at a high position in the middle of the arc extinguishing chamber assembly 60, so that the size of the arc extinguishing grid is designed to be high.

[0121] Referring to Figs. 71-74, a circuit breaker according to another embodiment of the present disclosure is shown, which is generally similar to the circuit breaker shown in Fig. 58. The difference of this embodiment is in that another guide member structure is used to imple-

ment the Laval nozzle channel 602, as shown in Figs. 71 and 72. This embodiment provides an alternative solution of the insulating vertical plate 693. The Laval nozzle channel consists of a plurality of first insulating plates 603 and second insulating plates 604 which are oppositely disposed and in approximately U-shaped clamping plate, wherein the first insulating plate 603 includes two guide members 6031. The two guide members 6031 are connected together on the side ends through the second connecting part 6032, so that the first insulating plate 603 is approximately U-shaped. The guide member 6031 has a projected part 6030. The second insulating plate 604 is similar to the first insulating plate 603 in structure, which includes two guide members 6041. The guide members 6041 are also connected through the connecting parts and are in approximately U-shaped clamping plate structure. The guide member 6041 has a projected part 6040. The first insulating plate 603 and the second insulating plate 604 are respectively inserted and connected to both sides of the arc extinguishing grid 630, so that the guide members 6041 and the guide members 6031 extend into the gap between two adjacent arc extinguishing grids 630. Every two adjacent arc extinguishing grids 630 (exposed surfaces not inserted into the first insulating plate 603 and the second insulating plate 604) and the projected parts 6030 and 6040 of the first insulating plate 603 and the second insulating plate 604 form a Laval nozzle channel 602'.

[0122] The first insulating plate 603 and the second insulating plate 604 in the shape of a U-shaped clamping plate are connected with the arc extinguishing grid 630, which is relatively simple. In other applications, each set of the first insulating plate 603 and the second insulating plate 604 are inserted at intervals to clamp the arc extinguishing grid 630, such as first, third, fifth, or second, fourth, sixth. Every two adjacent arc extinguishing grids are separated only by one of the projected parts 6030 and 6040 to form one Laval nozzle channel 602'. This solution may reduce the number of the guide members and reduce the cost. Such installation mode makes the arc voltage lower than that of installing the first insulating plate 603 and the second insulating plate 604 on each arc extinguishing grid, which is more suitable for occasions with low interruption voltage (380V/690V, etc.).

[0123] After the Laval nozzle channel is formed by using the above structure, in this embodiment, it is unnecessary that the partition plates 69" (corresponding to the first partition plate 69 and the second partition plate 69' in the first embodiment) disposed on both sides of the movable contact must have the insulating vertical plates 693 of the first partition plate 69 and the second partition plate 69' in first embodiment. Therefore, the partition plate 69" in this embodiment, as shown in Fig. 73, has the gas pressure-raising channel performing the same technical effect in first embodiment 1.

[0124] The shape of the opposite side of the first insulating plate 603 and the second insulating plate 604 are approximately matched with the shape of the notch of

the arc extinguishing grid 630 to reduce arc passing resistance.

[0125] This embodiment is different from the integrated design of the insulating vertical plate 693, the first partition plate 69 and the second partition plate 69' in the first embodiment, but the first insulation plates 603 and second insulation plates 604 opposite to each other are separately installed to form the Laval nozzle channel. Although the installation process is more complicated than that in the first embodiment, this structural design is more flexible, and the number of the first insulating plates 603 and the second insulating plates 604 can be configured according to different application occasions (different rated voltages, different interruption currents, etc.).

[0126] The arc extinguishing system in the above two embodiments is a small and medium-sized breaker suitable for the medium and low voltage and current fields, which performs gas blowing arc extinguishing on the electric arc generated during the interruption thereof. Except for applying in the circuit breaker mentioned above, the person skilled in the art could also apply it to knife switches, isolation switches, and contactors, etc.

[0127] Further, the arc extinguishing grid is a main structure for extinguishing the electric arc, but the length of the arc extinguishing grid in the existing circuit breaker is often limited to a volume of the circuit breaker, and the interruption energy is still relatively large in the process of the short circuit interruption, short arc extinguishing grid has an insufficient performance, it leads to the gas generated by the electric arc from the arc extinguishing chamber contain enough charged particles, so that the electric arc are easily short-circuited at the back end of the grids and between the grids, so that the burning time of the electric arc increases, the switch is burned seriously, and even the interruption failure occurs.

[0128] Therefore, the present disclosure proposes an arc extinguishing system with good arc extinguishing effect and a breaker with the arc extinguishing system.

[0129] The arc extinguishing system with good arc extinguishing effect is arranged opposite to the contact system and extinguish the electric arc generated by the contact system. The contact system is located on the upper end of the arc extinguishing system, and the arc extinguishing system is located on the lower end of the contact system, and the arc extinguishing system includes a plurality of arc extinguishing grid arranged at intervals. the arc extinguishing system further comprises an insulator, the insulator comprises insulating portions corresponding to a number of the arc extinguishing grid, the corresponding insulating portions abut against lower ends of the corresponding arc extinguishing grid and at least cover lower edges of the arc extinguishing grid, and the adjacent insulating portions are partitioned by an air gap.

[0130] In order to make the gas channel between the insulating portions and the gas channel between the arc extinguishing grids more coherent, in one embodiment, a width of the insulating portion is approximately identical to a thickness of the arc extinguishing grid, so that the

partition between the adjacent insulating portions is approximately identical to the partition of the adjacent arc extinguishing grids.

[0131] On the basis of installing and manufacturing consideration, in one embodiment, the insulators are a plurality of insulating monomer structures corresponding to a number of the arc extinguishing grids.

[0132] In order to shorten the arc extinguishing grid to optimize the appearance and volume of the circuit breaker, in one embodiment, the insulator is a generally U-shaped integrated structure, and the U-shaped integrated structure is a sheet structure in which snaps are provided on two upper ends, and snapping ports fit to the snaps are provided on two side ends of the arc extinguishing grid approximate to the lower edge respectively; the snap of the insulator cooperates with and is connected to the snapping port so that the insulator and the arc extinguishing grid are embedded and fixed to be an integrated sheet-like structure.

[0133] In order to assemble the arc extinguishing system and reduce the cost, in one embodiment, the arc extinguishing system further comprises a first clamping plate and a second clamping plate, the first clamping plate and the second clamping plate are respectively disposed on both sides of the arc extinguishing grid, the insulators are a plurality of first insulating rods and second insulating rods that are fixedly connected to the first clamping plate and the second clamping plate and have a number corresponding to the number of the first clamping plate and the second clamping plate, the plurality of first insulating rods are arranged in a comb-like at intervals on the first clamping plate, the plurality of second insulating rods are arranged in a comb-like at intervals on the second clamping plate, the corresponding first insulating rod and the corresponding second insulating rod extend to each other and docked with each other to form the insulating portion, the arc extinguishing grid is fixed between the first clamping plate and the second clamping plate, and the lower end of the arc extinguishing grid abuts against the insulating portion.

[0134] In order to realize tight docking and facilitate for assembly and operation through alignment in the docking process, in one embodiment, the first insulating rod and the second insulating rod are docked by a tenon-mortise structure at the respective opposite ends thereof.

[0135] In order to make the cooperation of the arc extinguishing grid and the insulating portion more stable, in one embodiment, the first insulating rod and the second insulating rod are a L-shaped structure with a step, the first insulating rod and the second insulating rod are docked to form the insulating portion in the U shape, and the lower end of the arc extinguishing grid is approximately surrounded by the insulating portion in the U shape.

[0136] On the basis of assembling and manufacturing consideration, in one embodiment, clamping grooves are provided vertically on the first clamping plate and the second clamping plate, the arc extinguishing grid are fixedly

inserted into the clamping grooves vertically.

[0137] On the basis of assembling and manufacturing consideration, in one embodiment, a hanger is also provided on the arc extinguishing grid, the first clamping plate and the second clamping plate have a receiving portion fit to the hanger, the hanger of the arc extinguishing grid is hanged on the receiving portion.

[0138] On the basis of assembling and manufacturing consideration, in one embodiment, the insulator is an insulating plate, a plurality of strip-like ventilation holes spaced apart are provided on the insulating plate, and the insulating portion is a solid portion of the insulator between every two adjacent ventilation holes.

[0139] In order to improve the arc extinguishing efficiency, in one embodiment, the insulating portion is made of materials that generate gas.

[0140] On the basis of the above arc extinguishing system, the present disclosure further proposes a breaker which has the above arc extinguishing system.

[0141] The arc extinguishing system with good arc extinguishing effect and the breaker having the arc extinguishing system have following beneficial effects: in this embodiment, the lower end of the arc extinguishing grid in the arc extinguishing system is configured to abut against the insulating portion, so that the electric arc is further deionized when the electric arc passes through the arc extinguishing grid and then through the insulating portion and a flying distance of the electric arc is reduced, and the insulating portion approximately covers the lower end of the arc extinguishing grid. Even if the electric arc with enough charged particles moves to this end, the insulating portion can eliminate the short-circuit phenomenon between the grids, thereby increasing the voltage of the electric arc, reducing the burning time of the electric arc, and improving the interruption capability of the circuit breaker.

[0142] Referring to Figs. 75-79, the arc extinguishing chamber assembly 60 of the circuit breaker includes arc extinguishing grids 63. An insulator abuts against the lower end of the arc extinguishing grid 63. The insulator includes insulating portions corresponding to the number of arc extinguishing grids 63. The insulator includes first insulating rods 701 and second insulating rods 702. The first insulating rods 701 and the second insulating rods 702 are rod-like structures extending from the first clamping plate 671 and the second clamping plate 672, respectively. The first insulating rods 701 are arranged in a comb-like shape at intervals on the first clamping plate 671. The second insulating rods 702 are arranged in a comb-like shape at intervals on the second clamping plate 672. The corresponding first insulating rod 701 and the corresponding second insulating rod 702 extend towards each other and are docked together to form the insulator. Each of the insulators forms an insulating portion 70. Specifically, as shown in Fig. 76, the opposite ends of the first insulating rod and the second insulating rod are docked by a tenon-mortise structure with mutually matched shapes. This not only can realize a tight docking,

but also has an alignment effect in the docking process, and thereby being more convenient for assembly and operation. In this embodiment, The first insulating rod 701 and the second insulating rod 702 are integrally formed on the first clamping plate 671 and the second clamping plate 672 as a single structure, so that the insulating rod and the clamping plate are integrally injection-molded during manufacturing. The manufacturing cost is low and the splicing process of the first clamping plate 671 and the second clamping plate 672 is simple. A clamping groove 6711 is provided vertically on the first clamping plate 671 (the second clamping plate 672 also has the clamping groove). The arc extinguishing grids 63 are vertically inserted into the clamping groove 6711. The lower ends of the arc extinguishing grids 63 abuts against the insulating portion 2470 and are carried by the insulating portion 70, so that the arc extinguishing grid 63 is embedded and fixed between the first clamping plate 671 and the second clamping plate 672. In this embodiment, the arc extinguishing grid 63 is carried by the insulating portion 70, and the arc extinguishing grid 63 is embedded through the clamping groove disposed on the clamping plate 67, so that when the arc extinguishing grid 63 is installed, it is feasible as long as it is inserted between the first clamping plate 671 and the second clamping plate 672 from top to bottom along the clamping groove, which installation is relatively simple and efficient. It is more important that since the lower end of the arc extinguishing grid 63 abuts against the insulating portion 70, the electric arc is further deionized when the electric arc passes through the arc extinguishing grid 63 and then through the insulating portion 70 here, thereby reducing the flying distance of the electric arc, and the insulating portion 70 approximately covers one end of the arc extinguishing grid 63 which is relatively far away from contact system 3. Even if the electric arc with enough charged particles moves to this end, the insulating portion 70 can eliminate the short circuit phenomenon between the grids, thereby increasing the voltage of the electric arc, reducing the burning time of the electric arc, and improving the interruption capability of the circuit breaker.

[0143] As shown in Fig. 81, the first insulating rod 701 and the second insulating rod 702 are L-shaped stepped structures, and they are docked to form a U-shaped insulating portion 70. The lower end of the arc extinguishing grid 63 has a trapezoidal structure fitted to the U-shape. In other embodiments, the insulating portion 70 may be a strip-like structure that only covers the lower edge of the arc extinguishing grid 63, such as the insulating portion 70 is in a "—" shape. It can realize the above-mentioned deionizing and short-circuit eliminating functions. However, in this embodiment, it is preferable that the insulating portion 70 is designed in a "U" shape to surround the lower end of the arc extinguishing grid 63, so that the protection scope of the insulating portion 70 is more complete, the function of eliminating the short circuit is more stable and reliable, and the contact and co-operation between the arc extinguishing grid 63 and the

insulating portion 70 is more stable.

[0144] In this embodiment, both the first insulating rod 701 and the second insulating rod 702 are comb-shaped structures with air gaps, so that the insulating portions 70 are corresponding to and spaced apart from the arc extinguishing grid 63 to form a fence shape. There is a certain air gap between adjacent insulating portions 70, so that the insulating portions 70 are attached to the lower end of the arc extinguishing grid 63, but not seal the gas channels between the adjacent arc extinguishing grids 63, so as to keep the smoothness of the electric arc entering the arc extinguishing chamber at the initial stage. In this embodiment, the width of the insulating portion 70 is approximately identical to the thickness of the arc extinguishing grid 63, so that the air gap between the insulating portion 70 is approximately identical to the air gap between the arc extinguishing grids 63, so as to further ensure the gas channel coherent.

[0145] Referring to Figs. 76 and 78 again, arc-shaped projected parts (the projected parts 6710 of the first clamping plate 671 as shown in the figures) are further provided on the opposite sides of the first clamping plate 671 and the second clamping plate 672, and the projected parts are inserted and disposed between the arc extinguishing grids 63. The two opposite projected parts form a contracted channel whose aperture changes from large to small, and then form an expanded channel whose aperture changes from small to large between the air gaps of the arc extinguishing grid 63, that is, a Laval nozzle channel whose aperture changes from large to small and contracts to the middle, and then expands from small to large. The gas is accelerated under the action of the Laval nozzle channel to further promote the movement of the electric arc. At the same time, the Laval nozzle channel with narrow aperture structure can further compress the electric arc, increase the voltage of the electric arc, deionize, and reduce the re-ignition of the electric arc.

[0146] Part of the arc extinguishing grids 63 are also provided with hangers 631, as shown in Fig. 80, and the first clamping plate 671 and the second clamping plate 672 are provided with receiving portions (such as the receiving portions 6720 of the second clamping plate 672 as shown in the figure) matched with the hangers 631. The hangers of the arc extinguishing grids 63 are hanged on the receiving portions, and are further fixed between the first clamping plate 671 and the second clamping plate 672.

[0147] The insulating portion 70 may be an insulating material without gas generation, such as BMC, SMC, GPO, phenolic mould, etc., or an insulating material with gas generation, such as nylon, melamine, POM, etc. In this embodiment, the insulating portion 70 is made of the insulating material with gas generation. Therefore, when the electric arc passes through the insulating portion 70, the insulating portion 24 is burned to generate gas, and the gas flow pushes the electric arc to move and quickly takes away the heat in the arc extinguishing system.

[0148] The structure of the arc extinguishing system provided by this embodiment may be applied to different current levels, especially in the case of small current. In the case of small current, an intensity of the electric arc generated by the contact system is not high, and the number is small, so that it is easy to gather at the tip of the grids through the arc extinguishing grids.

[0149] In this embodiment, the specific structure and function of the arc extinguishing system is illustrated by taking the circuit breaker as an example, the arc extinguishing system provided in this embodiment may also be used in other breakers, such as knife gates, isolation switches, and contactors, etc.

[0150] Referring to Figs. 82-85, another embodiment of the circuit breaker is shown. The circuit breaker includes a contact system and an arc extinguishing system arranged in the same manner as that of the embodiment shown in Fig. 75. The arc extinguishing system is similar to the arc extinguishing system in the embodiment shown in Fig. 75, and has part of the same structures, such as gas generating insulating plate, the Laval nozzle channel, etc., but this embodiment is different from the embodiment shown in Fig. 75 in the structure of the insulator. In this embodiment, the insulator has a plurality of insulating monomer structures corresponding to the number of arc extinguishing grids 63. As shown in Figs. 82-85, the arc extinguishing system includes arc extinguishing grids 63' and insulating snaps 70'. An insulating snap 2470' is embedded on the end of the arc extinguishing grid 63' which is relatively far away from the contact system. Specifically, the insulating snap 70' is an approximately U-shaped integrated structure and includes an insulating portion 70' 3 in an approximate U shape and a first snapping portion 70' 1 and a second snapping portion 70' 2 connected to the upper ends of the insulating portion 70' 3. The arc extinguishing grid 63' has a first snapping port 63' 1 and a second snapping port 63' 2 which are matched with the first snapping portion 70' 1 and the second snapping portion 70' 2 on the two side sides adjacent to the lower edges. The first snapping portion 70' 1 and the second snapping portion 70' 2 of the insulating snap 70' are embedded and fixed in the first snapping port 63' 1 and the second snapping port 63' 2 of the arc extinguishing grid 63', so that the insulating snap 70' and the arc extinguishing grid 63' are connected into an integrated sheet-like structure. The U-shaped insulating portion 70' 3 surrounds and embedded with the end of the arc extinguishing grid 63', so that when the electric arc passes through the arc extinguishing grid 63' and then passes through the insulating snap 70' here to be further deionized, and the flying distance of the electric arc is reduced. Moreover, even if the electric arc with enough charged particles moves to this end, the insulating snap 70' can eliminate the short circuit phenomenon between the grids, thereby increasing the voltage of the electric arc, reducing the burning time of the electric arc, and improving the interruption capability of the circuit breaker.

[0151] In this embodiment, the insulating snap 70' is

embedded at the end of the arc extinguishing grid 63', which can shorten the length of the arc extinguishing grid, thereby optimizing appearance and volume of the circuit breaker and reducing the installation and use space. At the same time, the insulating snap 70' as same as the insulating portion 70 in the embodiment shown in Fig. 75 cannot enclose the gas channel between the adjacent arc extinguishing grids 63. Moreover, the installation mode of directly embedding the insulating portion at the end of the arc extinguishing grid cannot take other installation structures (such as grid mounting plates) for consideration, and various arc extinguishing systems with different structures can be used.

[0152] Referring to Fig. 86, another embodiment of the circuit breaker is shown. The circuit breaker has a structure (such as the gas generating insulating plate, and the Laval nozzle channel etc.) as same as that in the embodiment shown in Fig. 75, but the structure of the insulator in this embodiment is different from that of the embodiment shown in Fig. 75. Referring to Fig. 86, the insulator in this embodiment is a whole insulating plate 100 which is fixedly installed on the bottom of the arc extinguishing grid. A plurality of strip-shaped vent holes 110 spaced apart are arranged on the insulating plate 100. The insulating plate 100 has insulating portions 120 corresponding to the number of the arc extinguishing grids. The insulating portion 120 is a solid part between every two adjacent vent holes 110. In this embodiment, the vent holes 110 are provided on an integrated insulating plate 100 to separate the insulating portions 120, and each of the insulating portions 120 corresponds to one of the arc extinguishing grids. This is very convenient in manufacturing and can save cost and manufacturing process.

[0153] It should be understood that the present disclosure is not limited to the detailed structure and arrangement of components as set forth in this specification. The present disclosure can have other embodiments, and can be implemented and executed in various ways. The foregoing variations and modifications fall within the scope of the present disclosure. It should be understood that the present disclosure disclosed and defined in this specification extends to all alternative combinations of two or more separate features mentioned or indicated in the text and/or drawings. All these different combinations constitute many alternative aspects of the present disclosure. The well-known best modes for implementing the present disclosure are illustrated in the embodiments of this specification, and thus can be available to the person skilled in the art.

Claims

1. A circuit breaker, comprising a circuit breaker housing, a release, a locking mechanism, an operating mechanism, a contact system and an arc extinguishing system, the contact system comprising a movable contact and a stationary contact, the movable

contact being movable with respect to the stationary contact to perform conduction or interruption, and movement of the movable contact forming a movement trajectory, **characterized in that** the contact system is approximately arranged at a central position; the release, the locking mechanism, the operating mechanism and the arc extinguishing system are approximately arranged on a periphery in a manner of surrounding the contact system, wherein the movement trajectory of the contact system is located under the contact system, the locking mechanism crosses above the contact system, the release and the operating mechanism are respectively disposed on both sides of the contact system, the arc extinguishing system is disposed under the contact system in a manner of at least partially covering the movement trajectory.

2. The circuit breaker according to claim 1, **characterized in that** the locking mechanism at least comprises a releasing half shaft and a tripping piece lapped and fitted with the releasing half shaft, the tripping piece crosses above the contact system, the release is linkedly disposed on one side close to the releasing half shaft, the operating mechanism is linkedly disposed on the other side close to the tripping piece.
3. The circuit breaker according to claim 1, **characterized in that** the circuit breaker housing comprises a base, an interior of the base has an approximately enclosed installation space, the contact system and the arc extinguishing system are both located in the installation space.
4. The circuit breaker according to claim 3, **characterized in that** the circuit breaker housing further comprises a base plate located on the base, the base plate forms an opened space, the locking mechanism and the operating mechanism are both located in the opened space.
5. The circuit breaker according to claim 1, **characterized in that** the arc extinguishing system is disposed under the contact system in a manner of entirely covering the movement trajectory, and a length of the arc extinguishing system is approximately equal to a maximum length of the circuit breaker housing.
6. The circuit breaker according to claim 5, **characterized in that** the arc extinguishing system comprises a first running arc channel relatively close to the movable contact, a second running arc channel relatively close to the stationary contact, and an arc extinguishing grid set, wherein the first running arc channel has an abdication space in which the movable contact moves along the movement trajectory, the arc extinguishing grid set is disposed under the movable contact and the stationary contact, the first running arc

channel is flush with one tip of the arc extinguishing grid set, the second running arc channel is flush with the other tip of the arc extinguishing grid set.

7. The circuit breaker according to claim 2, **characterized in that** the circuit breaker further comprises a releasing link mechanism, the movable contact comprises a movable contact surface located on one end of a rotational point and a fitting surface located on the other end of the rotational point, a trigger is disposed on the releasing half shaft, when the movable contact is rotationally movable, the releasing link mechanism is used to convert the movement trajectory of the fitting surface into a driving force for flicking the trigger on the releasing half shaft, so that the releasing half shaft rotates and the locking mechanism moves to an unlocking position.
8. The circuit breaker according to claim 7, **characterized in that** the releasing link mechanism comprises a third link and a traction element, the third link comprises a first fitting portion and a second fitting portion, the traction element has a third fitting portion and a driving portion, the third link is disposed to close the first fitting portion to the fitting surface, the second fitting portion of the third link cooperates with the third fitting portion of the traction element, the driving portion cooperates with the trigger, when the movable contact is rotatably movable, the fitting surface of the movable contact is converted to a pushing force against the third link by cooperation with the first fitting portion, so that the third link rotates in a direction toward the traction element, when the third link rotates toward the traction element, the pushing force against the third link is converted to a rotating force against the traction element by cooperation of the second fitting portion and the third fitting portion, so that the driving portion has a driving force of flicking the trigger.
9. The circuit breaker according to claim 7, **characterized in that** the third link and the movable contact are both rotatably connected and disposed on the same movable component.
10. The circuit breaker according to claim 8, **characterized in that** the third link is a block structure approximately in a "d" shape, comprises a second projection forming a main body of the "d", a first projection projecting towards the fitting surface, and a tip distant from both of the first projection and the second projection, the tip is pivotally disposed, the first projection serves as the first fitting portion, the second projection serves as the second fitting portion.
11. The circuit breaker according to claim 8, **characterized in that** the traction element is a block structure approximately in a "c" shape, comprises a base body portion pivotally disposed, a first projected portion extending to an outside of the base body portion and serving as a third fitting portion, and a driving portion extending to an outside of the base body portion, the first projected portion cooperates with the second fitting portion of the third link, the driving portion has a structure in a shape of curved hook, a tip of the driving portion serves as a force-applying point of a driving force for flicking the trigger.
12. The circuit breaker according to claim 11, **characterized in that** the traction element further comprises a second projected portion extending and projecting toward outside of the base body portion, the second projected portion has a plate-shaped structure of a plane towards to a direction of the arc extinguishing system.
13. The circuit breaker according to claim 7, **characterized in that** the releasing half shaft has a base body portion in an approximately cylindrical shape, a first groove is provided tangentially on an outer circle of the base body portion, a stepped structure engaged with the first groove is provided on one end of the first groove, both the releasing half shaft and the tripping piece are rotatably disposed, one end of the tripping piece is lapped on the stepped structure, and when the releasing half shaft rotates, one end of the tripping piece is disengaged with the stepped structure, and falls into the first groove, the tripping piece is a sheet-shaped structure having an lapped portion in a curved hook shape at one end, the lapped portion of the tripping piece is lapped on the stepped structure.
14. The circuit breaker according to claim 13, **characterized in that** the releasing half shaft further comprises a collar, the collar is sleeved on the base body portion, a second groove is tangentially provided along a periphery of the collar, when the collar is sleeved on the base body portion, the second groove and the outer circle of the base body portion form the stepped structure.
15. The circuit breaker according to claim 13, **characterized in that** the trigger is a paddle structure in a plate shape and has a notch approximately equal to a width of the first groove, the notch and first groove together form an abdication space in which the tripping piece falls down.
16. The circuit breaker according to claim 7, **characterized in that** the locking mechanism further comprises a limiting mechanism for limiting a rotation angular range of the releasing half shaft and a resetting member for applying a resetting force of the movement from the unlocking position to the locking position to the releasing half shaft.

17. The circuit breaker according to claim 16, **characterized in that** a fan-shaped groove is provided on the circuit breaker housing, the releasing half shaft has an extension portion approximately in "L" shaped structure, the extension portion is not coaxial with the releasing half shaft and extends in an axial direction of the releasing half shaft, the releasing half shaft is rotatably assembled onto the circuit breaker housing, when the releasing half shaft is assembled onto the circuit breaker housing, a first extension portion is inserted into the fan-shaped groove, to form the limiting mechanism.
18. The circuit breaker according to claim 6, **characterized in that** magnetism increasing components are disposed around the movable contact, the magnetism increasing components enclose to form a magnetism increasing space approximately surrounding the stationary contact and the movable contact.
19. The circuit breaker according to claim 18, **characterized in that** an movement of the movable contact with respect to the stationary contact is constructed to present the movement trajectory of the conduction or interruption, the magnetism increasing components comprises two oppositely disposed first magnetism increasing blocks disposed on both sides of the movement trajectory of the movable contact, and a second magnetism increasing block and a third magnetism increasing block respectively disposed on both ends of the movement trajectory of the movable contact.
20. The circuit breaker according to claim 19, **characterized in that** a first U-shaped groove is provided on the second magnetism increasing block, two oppositely disposed first magnetism increasing block and the third magnetism increasing block are connected to form a second U-shaped groove, so that the first U-shaped groove and the second U-shaped groove enclose to form the magnetism increasing space.
21. The circuit breaker according to claim 6, **characterized in that** the first running arc channel and the movable contact are equipotentially connected, the second running arc channel and the stationary contact are equipotentially connected, the first running arc channel is disposed close to a side of the movable contact.
22. The circuit breaker according to claim 21, **characterized in that** one end of the movable contact relatively close to the first running arc channel is a structure extended in a hook shape approximately toward the first running arc channel.
23. The circuit breaker according to claim 19, **characterized in that** the first running arc channel comprises a base body portion extended linearly, a first end of the base body portion is close to the movable contact, the first end of the base body portion is connected to an engaged portion extended bendably, one end of the engaged portion and the movable contact are equipotentially connected, the engaged portion and the base body portion form an approximately semi-enclosed installation space, the second magnetism increasing block is mounted in the installation space.
24. The circuit breaker according to claim 23, **characterized in that** the engaged portion and the movable contact are staggered.
25. The circuit breaker according to claim 19, **characterized in that** the second running arc channel is welded to the stationary contact, the second running arc channel and the stationary contact form an approximately semi-enclosed installation space, the third magnetism increasing block is mounted in the installation space.
26. The circuit breaker according to claim 25, **characterized in that** two ends of the third magnetism increasing block in a width direction are exposed out of the installation space, the first magnetism increasing block are contacted and connected with two ends of the third magnetism increasing block in the width direction, to form the second U-shaped groove.
27. The circuit breaker according to claim 6, **characterized in that** the arc extinguishing grid set comprises a plurality of arc extinguishing grid spaced apart from one another, the circuit breaker further comprises a gas pressure-raising channel disposed outside the arc extinguishing grid set, it is defined that a side facing to the gas pressure-raising channel is an upper side, a side facing to the arc extinguishing grid set is a lower side, and further comprises at least one pair of guide members disposed in pair, at least one set of projected parts that are oppositely disposed and projected to each other is provided on respective opposite sides of each pair of the guide members, there is a grid gap between two adjacent arc extinguishing grids in the arc extinguishing grid set, the projected parts is entirely inserted into a position close to the lower end of the grid gap, a Laval nozzle channel is formed by at least one set of projected parts and two adjacent arc extinguishing grids, the gas pressure-raising channel is a structure with an opening having a diameter gradually expanded toward the arc extinguishing grid set and in communication with the Laval nozzle channel, so that gas generated by the arc extinguishing system is pressurized by the gas pressure-raising channel located on the upper side, and then is discharged from the

Laval nozzle channel located on the lower side.

28. The circuit breaker according to claim 27, **characterized in that** the guide members are approximately in a strip-sheet shaped structure, each pair of the guide members facing to each other are inserted into the grid gap, so that the projected parts are interposed in the grip gap to substantially fill and enclose the gaps on both sides of the grip gap.
29. The circuit breaker according to claim 28, **characterized in that** there is a plurality of guide members, all of the guide members are spaced apart from one another and upper ends of the guide members are fixedly connected to the same first connecting part to form an integrated comb-like structure, all of the guide members are integrally inserted into the grid gap of the arc extinguishing grid set by the integrated comb-like structure.
30. The circuit breaker according to claim 29, **characterized in that** there is the plurality of guide members, every two of the guide members are spaced apart in parallel and side ends of the two guide members are fixedly connected to a second connecting part to form a U-shaped plate structure, so that the guide members are respectively inserted into the grip gap from both sides of the arc extinguishing grid set by a plurality of U-shaped plate structures in pair.
31. The circuit breaker according to claim 30, **characterized in that** the plurality of U-shaped plate structures are inserted one by one or inserted by separating one of the arc extinguishing grids therebetween.
32. The circuit breaker according to claim 27, **characterized in that** the gas pressure-raising channel is disposed in a manner of covering the movement trajectory of the movable contact of the contact system.
33. The circuit breaker according to claim 32, **characterized in that** a first partition plate and a second partition plate oppositely disposed on both sides of the movement trajectory of the movable contact of the contact system are respectively disposed outside the arc extinguishing grid set, the first partition plate and the second partition plate have a first raised portion and a second raised portion extending and projecting to each other on the respective opposite sides thereof, respectively; the first partition plate and the second partition plate further have a first slope and a second slope engaged with the first raised portion and the second raised portion on the respective opposite sides of the first partition plate and the second partition plate, the first slope and the second slope oppositely disposed are combined to form the gas pressure-raising channel gradually ex-

panded approximately toward the arc extinguishing grid set.

34. The circuit breaker according to claim 27, **characterized in that** the circuit breaker further comprises a distributor approximately disposed on a lower side of a discharge port of the Laval nozzle channel, the distributor comprises a pointed cone structure formed by docking two inclined surfaces, wherein the inclined surface is inclined to the Laval nozzle channel, to guide the gas discharged via the Laval nozzle channel toward two directions away from each other along a length direction of the arc extinguishing grid set.
35. The circuit breaker according to claim 27, **characterized in that** the distributor is disposed at a middle position in a length of the arc extinguishing grid set or disposed at a position directly facing to a contact position of the movable contact and the stationary contact of the contact system.
36. The circuit breaker according to claim 27, **characterized in that** the guide members are made of insulating gas-generated materials.
37. The circuit breaker according to claim 6, **characterized in that** the arc extinguishing system further comprises an insulator, the insulator comprises insulating portions corresponding to a number of the arc extinguishing grid, the corresponding insulating portions abut against lower ends of the corresponding arc extinguishing grid and at least cover lower edges of the arc extinguishing grid, and the adjacent insulating portions are partitioned by an air gap.
38. The circuit breaker according to claim 37, **characterized in that** a width of the insulating portion is approximately identical to a thickness of the arc extinguishing grid, so that the partition between the adjacent insulating portions is approximately identical to the partition of the adjacent arc extinguishing grids.
39. The circuit breaker according to claim 37, **characterized in that** the insulators are a plurality of insulating monomer structures corresponding to a number of the arc extinguishing grids.
40. The circuit breaker according to claim 39, **characterized in that** the insulator is a generally U-shaped integrated structure, and the U-shaped integrated structure is a sheet structure in which snaps are provided on two upper ends, and snapping ports fit to the snaps are provided on two side ends of the arc stretching grid approximate to the lower edge respectively; the snap of the insulator cooperates with and is connected to the snapping port so that the

insulator and the arc extinguishing grid are embedded and fixed to be an integrated sheet-like structure.

41. The circuit breaker according to claim 37, **characterized in that** the circuit breaker further comprises first clamping plates and second clamping plates, the first clamping plates and the second clamping plates are respectively disposed on both sides of the arc extinguishing grid, the insulators are a plurality of first insulating rods and second insulating rods that are fixedly connected to the first clamping plates and the second clamping plates and have a number corresponding to the number of the first clamping plates and the second clamping plates, the plurality of first insulating rods are arranged in a comb-like at intervals on the first clamping plate, the plurality of second insulating rods are arranged in a comb-like at intervals on the second clamping plate, the corresponding first insulating rod and the corresponding second insulating rod extend to each other and docked with each other to form the insulating portion, the arc extinguishing grid is fixed between the first clamping plate and the second clamping plate, and the lower end of the arc extinguishing grid abuts against the insulating portion.
42. The circuit breaker according to claim 41, **characterized in that** the first insulating rod and the second insulating rod are docked by a tenon-mortise structure at the respective opposite ends thereof.
43. The circuit breaker according to claim 41, **characterized in that** the first insulating rod and the second insulating rod are a L-shaped structure with a step, the first insulating rod and the second insulating rod are docked to form the insulating portion in the U shape, and the lower end of the arc extinguishing grid is approximately surrounded by the insulating portion in the U shape.
44. The circuit breaker according to claim 41, **characterized in that** clamping grooves are provided vertically on the first clamping plate and the second clamping plate, the arc extinguishing grid are fixedly inserted into the clamping grooves vertically.
45. The circuit breaker according to claim 41, **characterized in that** a hanger is also provided on the arc extinguishing grid, the first clamping plate and the second clamping plate have a receiving portion fit to the hanger, the hanger of the arc extinguishing grid is hung on the receiving portion.
46. The circuit breaker according to claim 37, **characterized in that** the insulator is an insulating plate, a plurality of strip-like ventilation holes spaced apart are provided on the insulating plate, and the insulating portion is a solid portion of the insulator between

every two adjacent ventilation holes.

47. A multi-pole circuit breaker, comprising N single-pole circuit breakers arranged side by side, wherein $2 \leq N \leq 4$, wherein at least one of the single-pole circuit breakers is the circuit breaker according to anyone of claims 1-46.
48. The multi-pole circuit breaker according to claim 47, **characterized in that** contact systems of the N single-pole circuit breakers are linked in series through a connecting structure, to achieve simultaneous movement of the contact systems of the N single-pole circuit breakers.

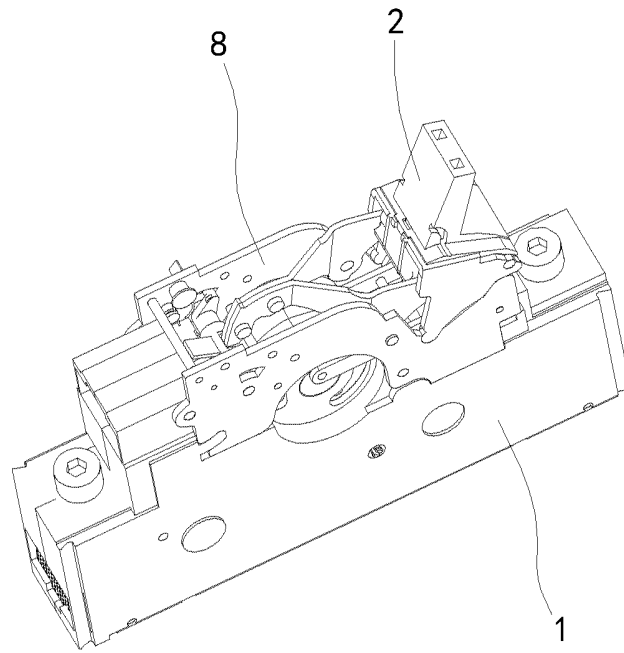


FIG.1

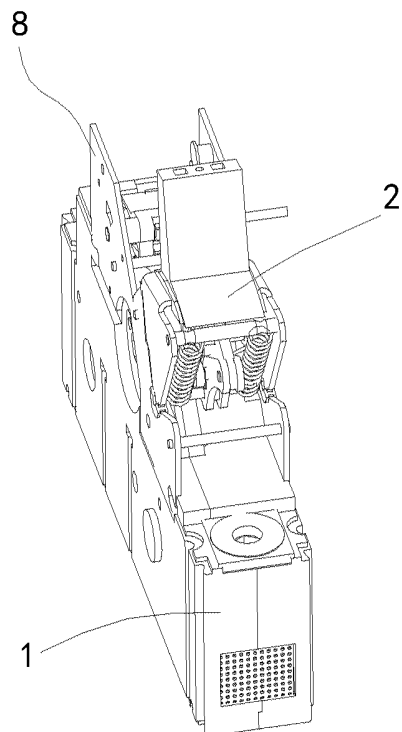


FIG.2

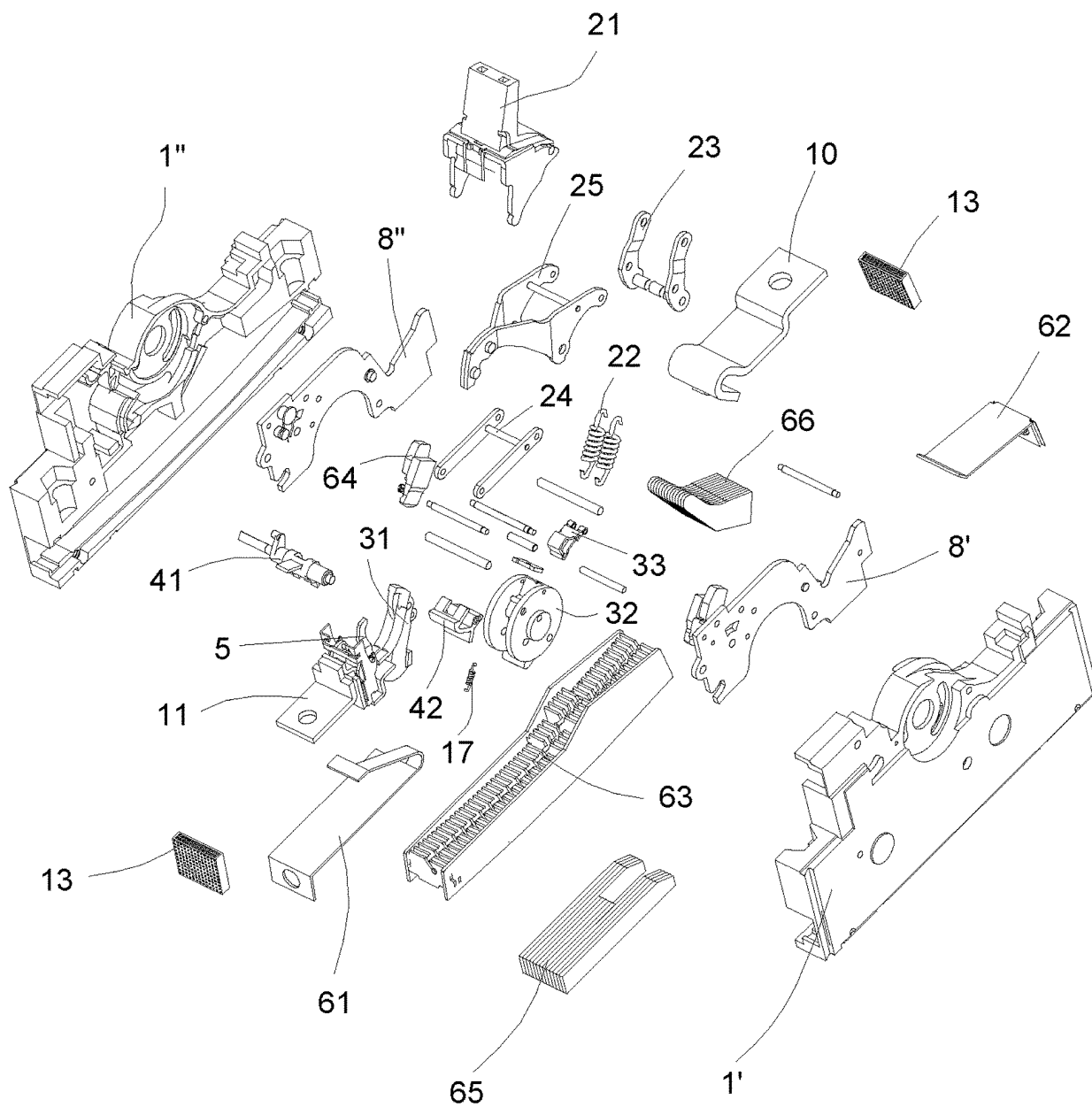


FIG.3

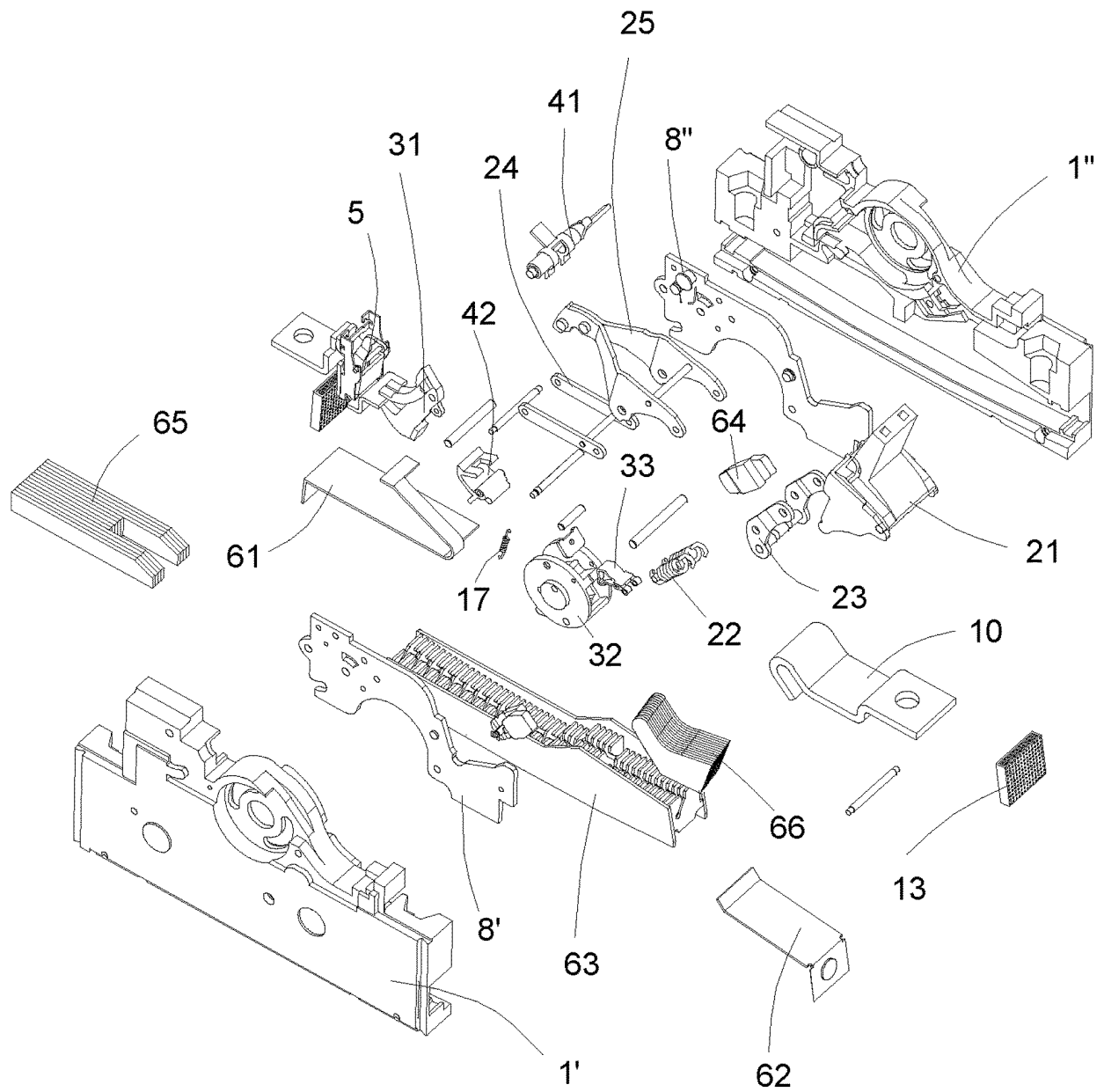


FIG.4

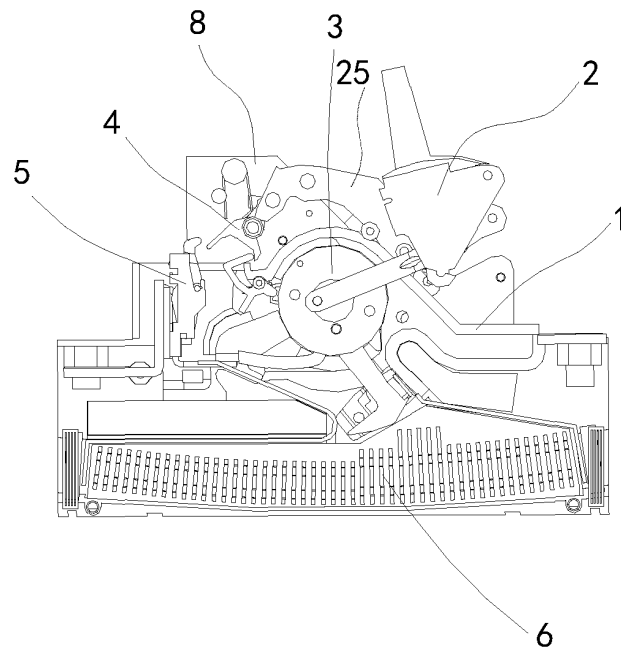


FIG. 5

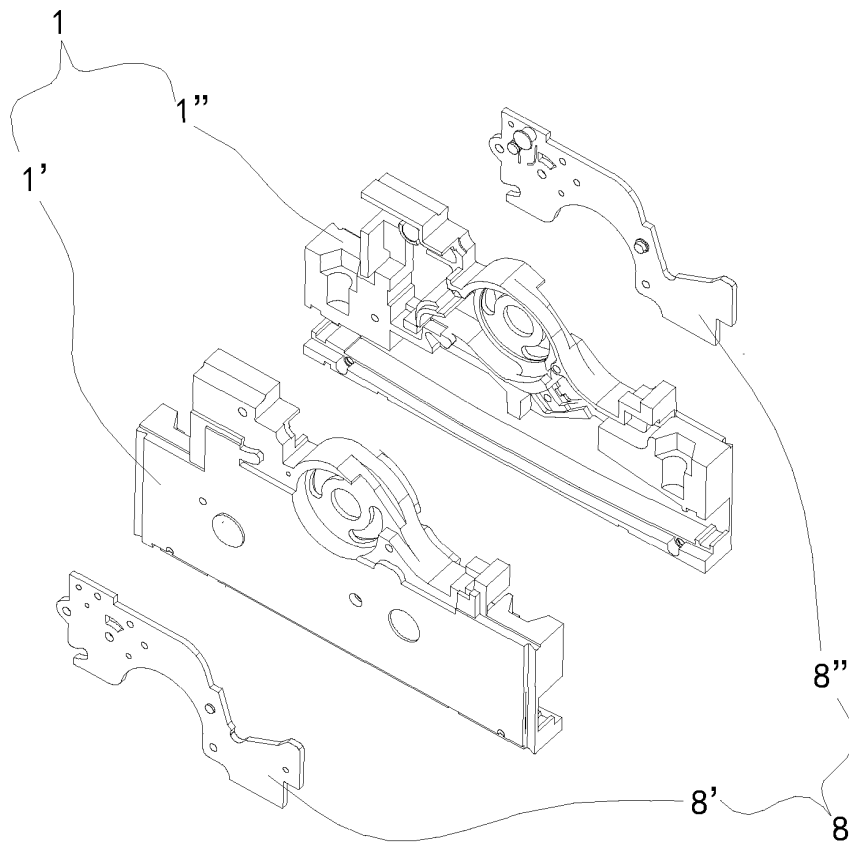


FIG. 6

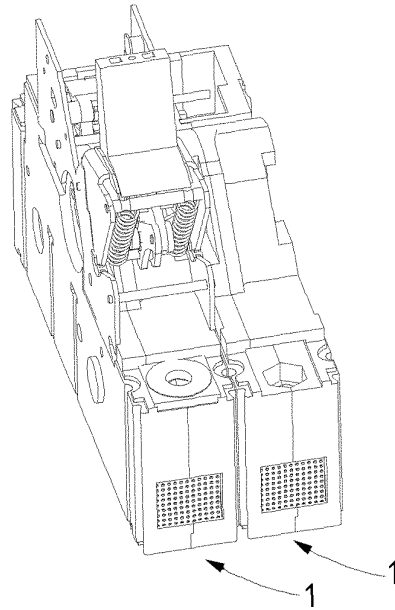


FIG. 7

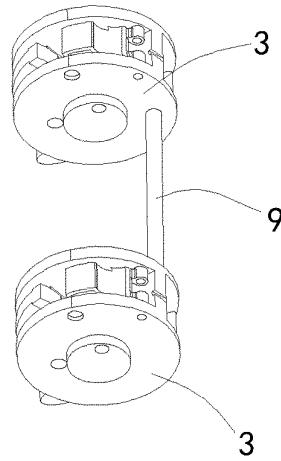


FIG. 8

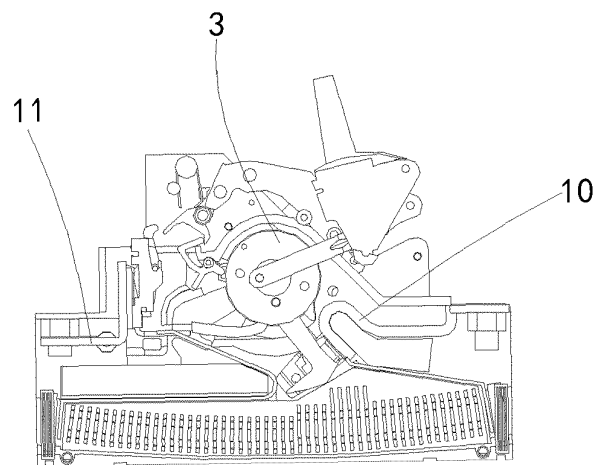


FIG. 9

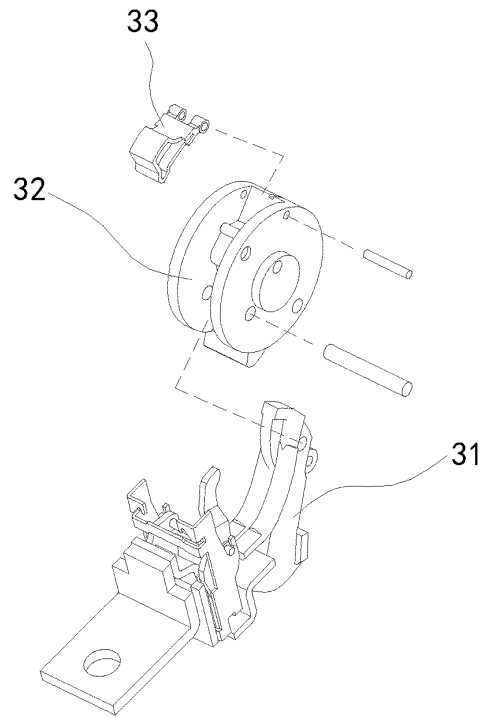


FIG.10

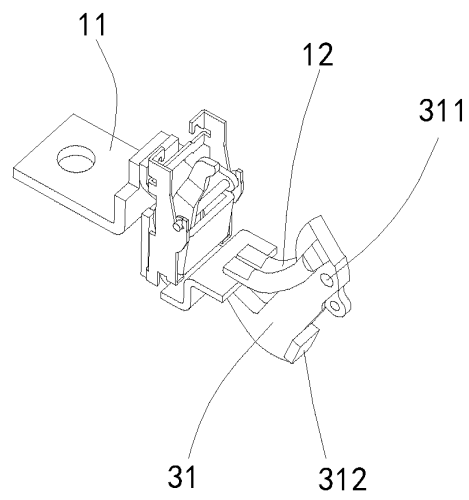


FIG.11

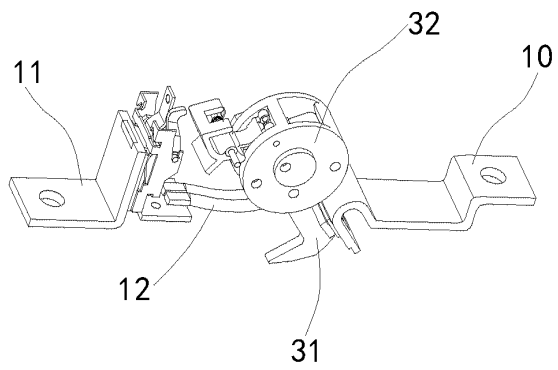


FIG.12

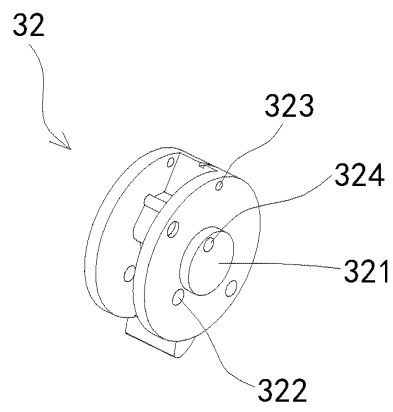


FIG. 13

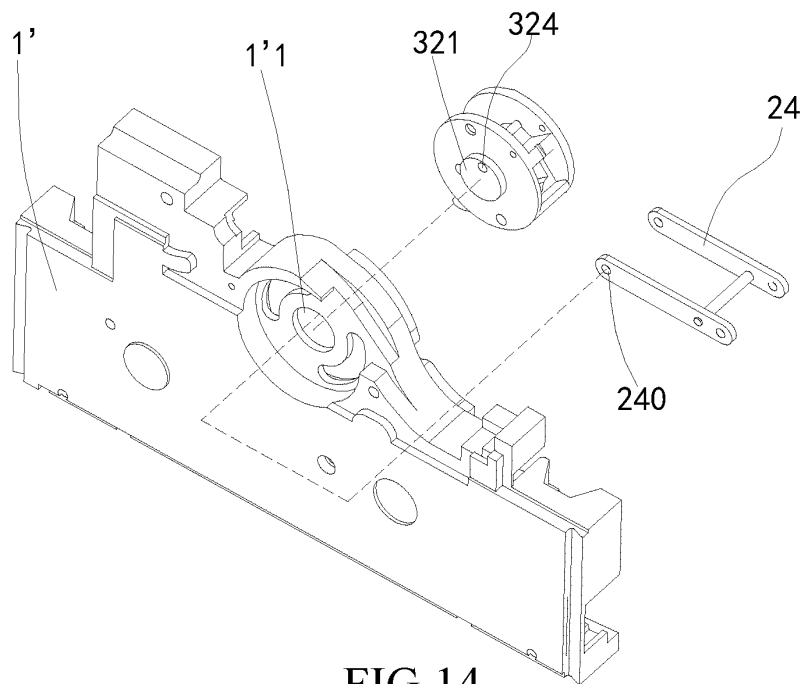


FIG. 14

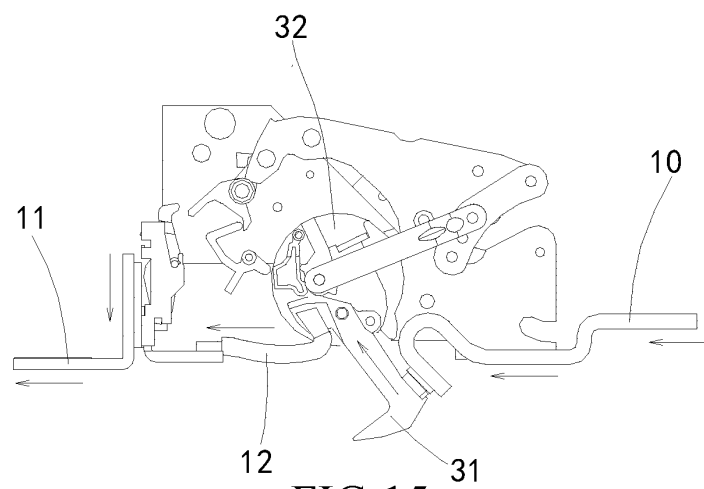


FIG. 15

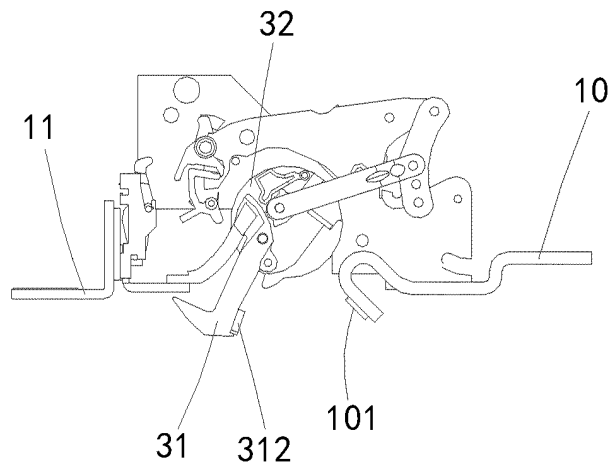


FIG. 16

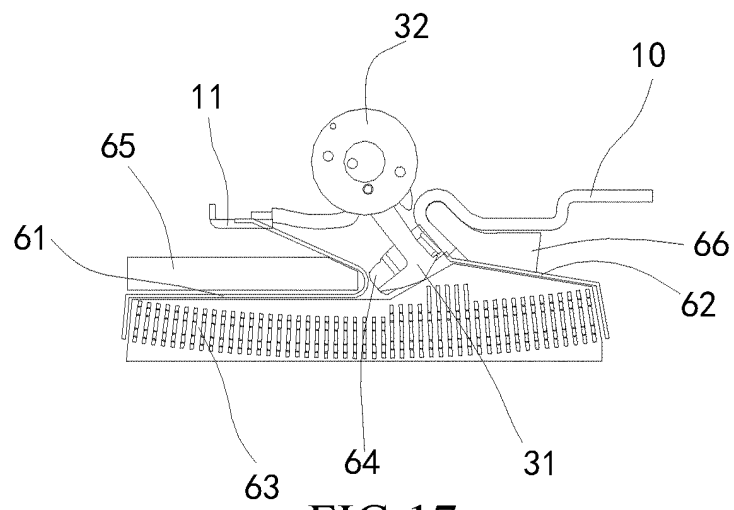


FIG. 17

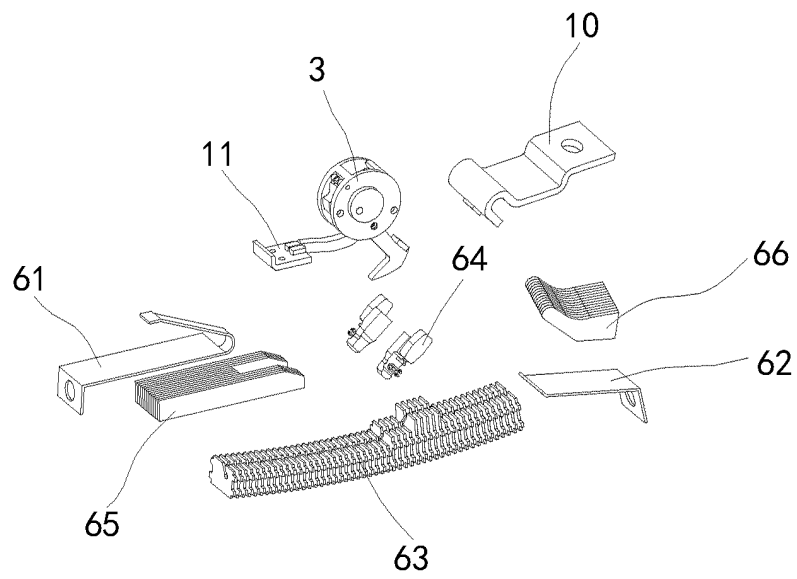
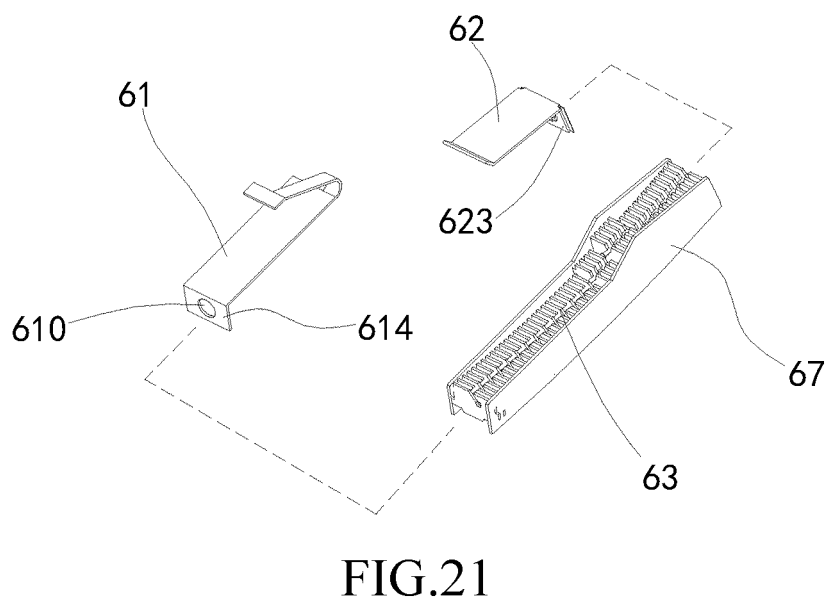
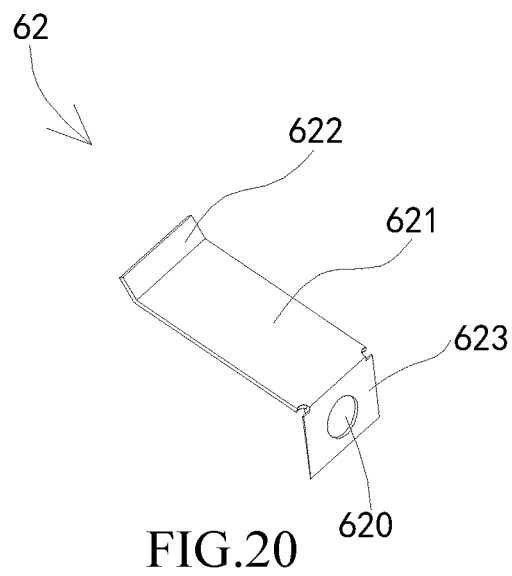
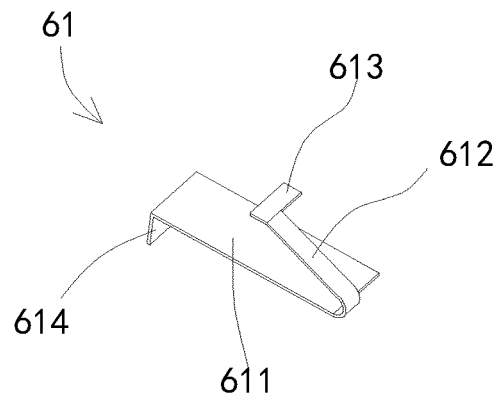


FIG. 18



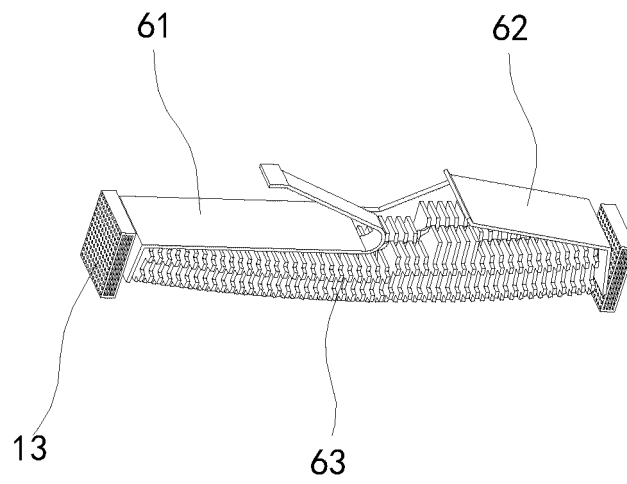


FIG. 22

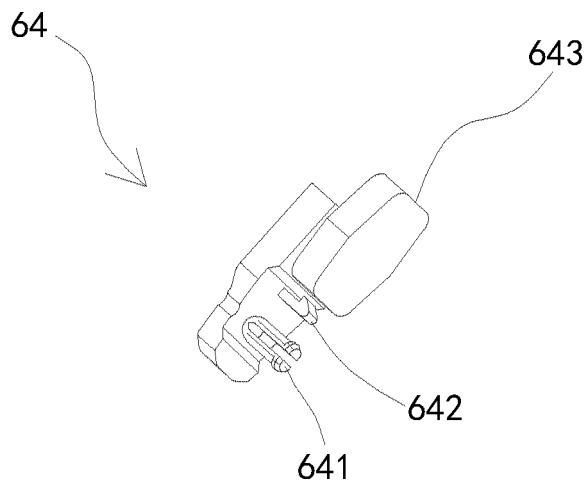


FIG. 23

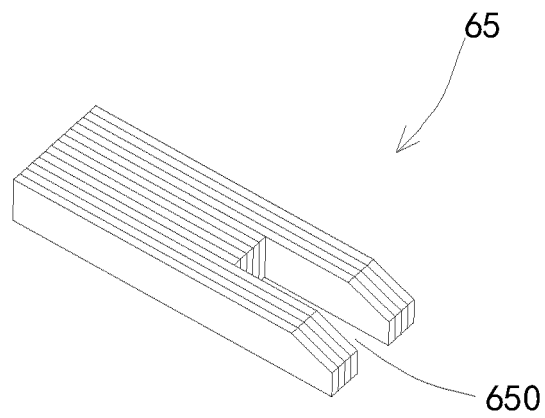


FIG. 24

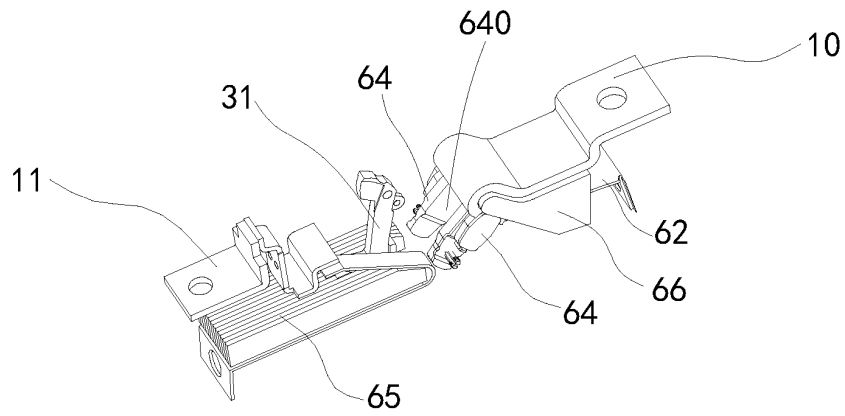


FIG. 25

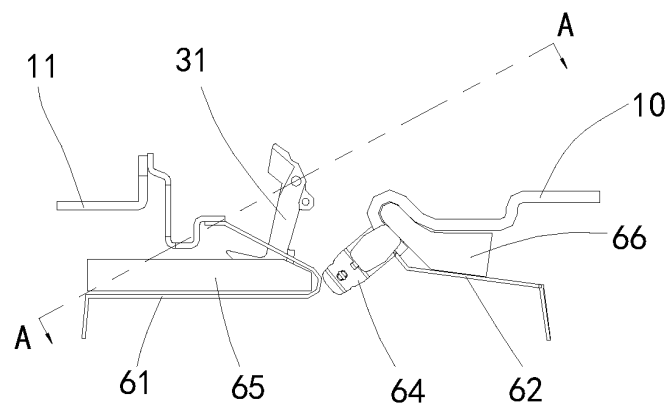


FIG. 26

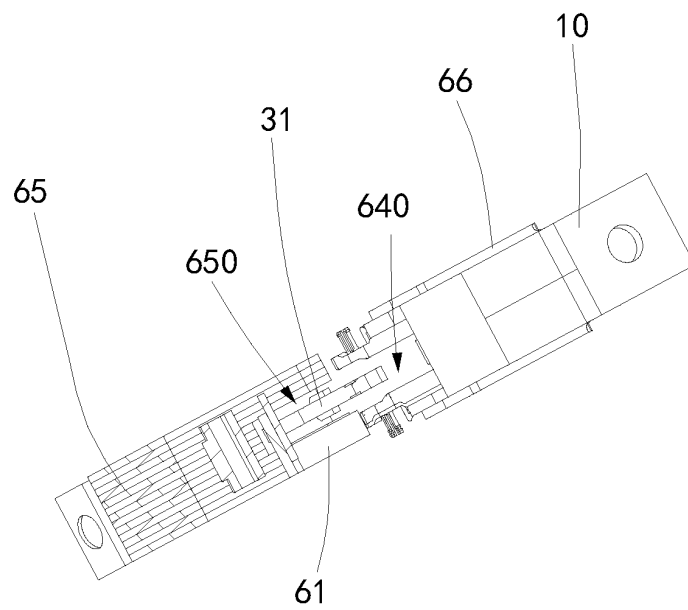


FIG. 27

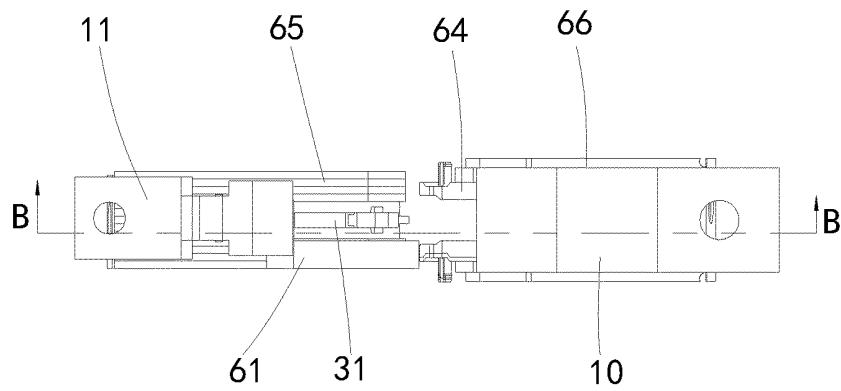


FIG.28

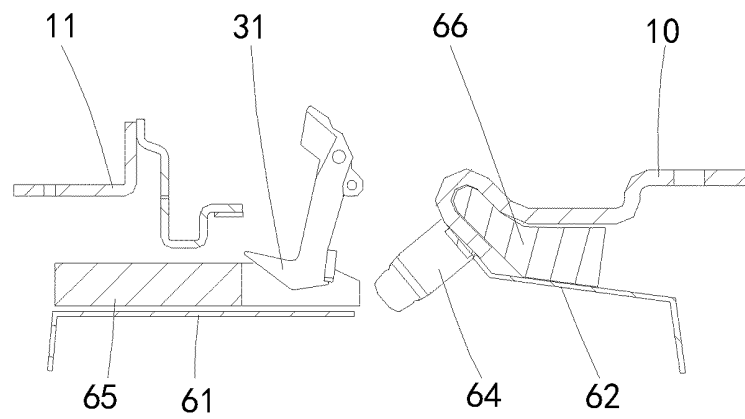


FIG.29

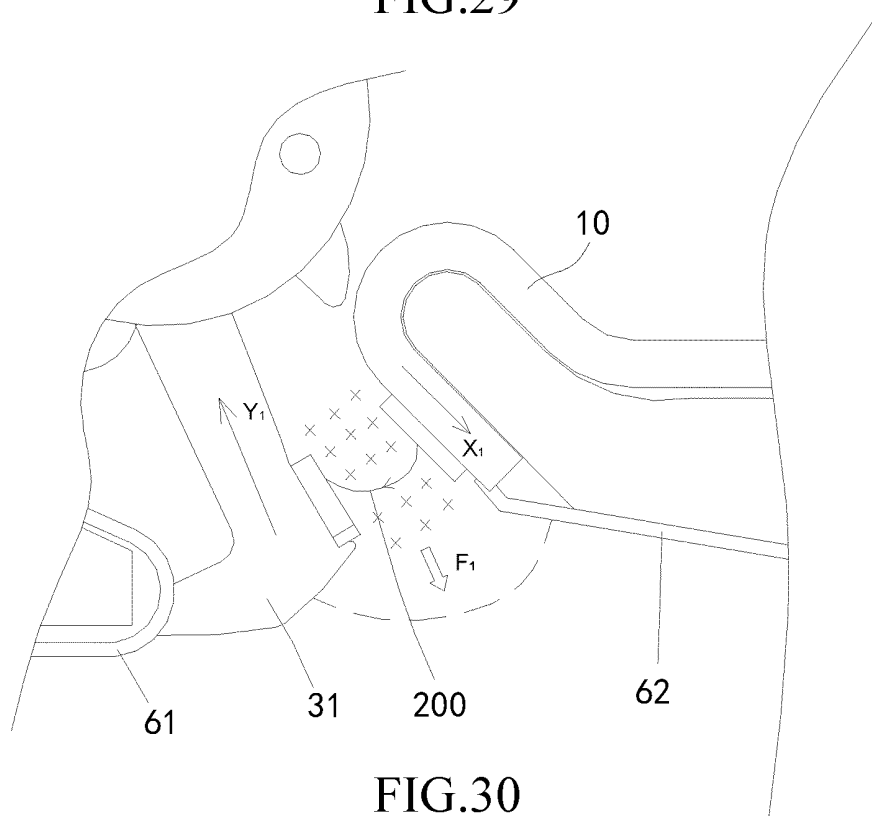
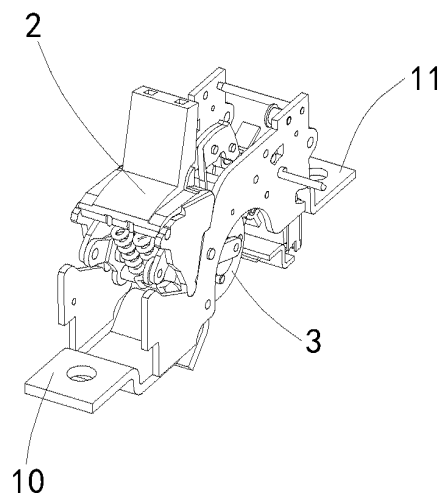
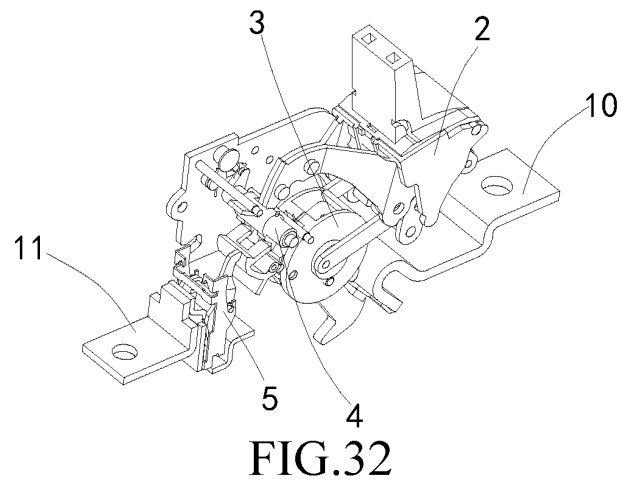
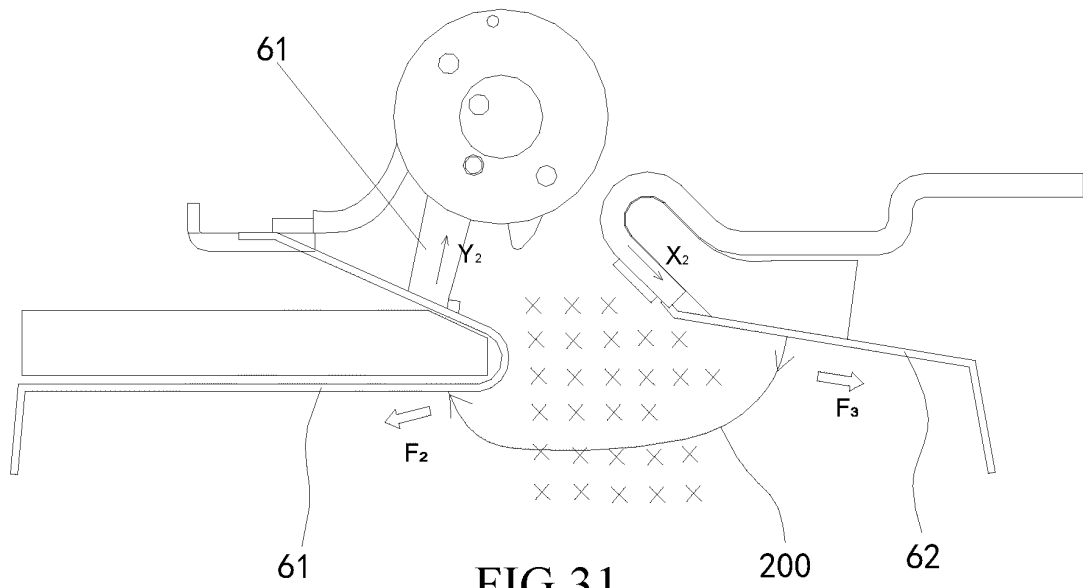


FIG.30



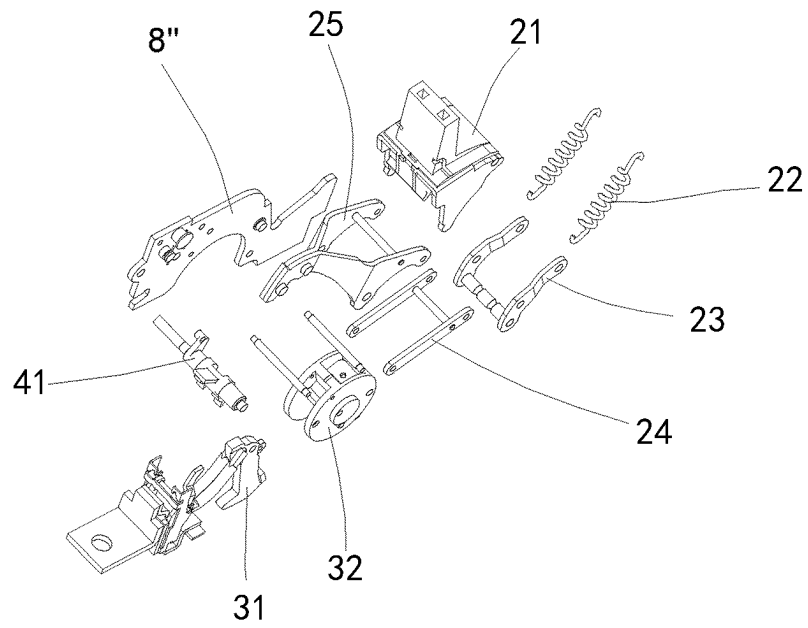


FIG.34

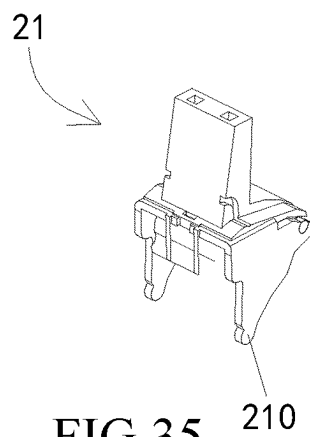


FIG.35

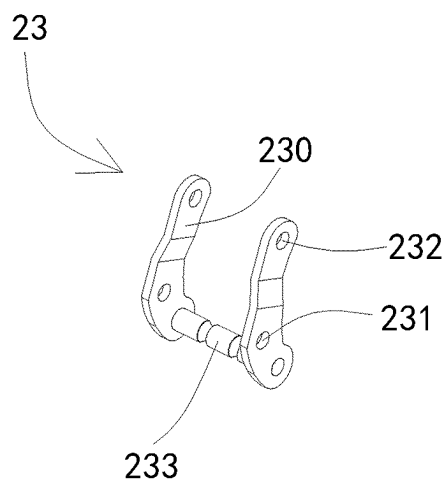


FIG.36

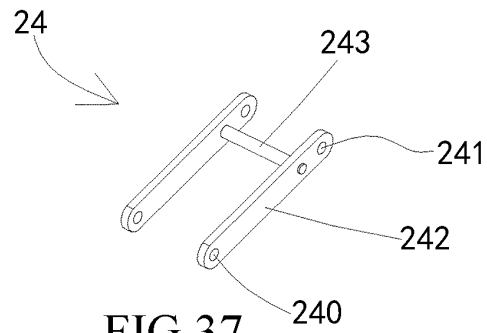


FIG.37

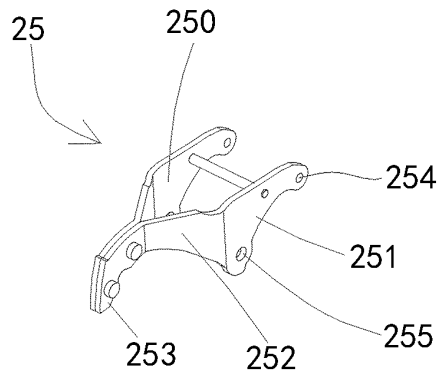


FIG.38

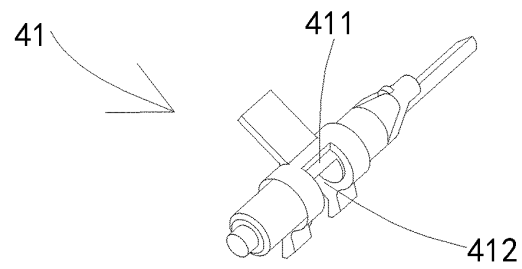


FIG.39

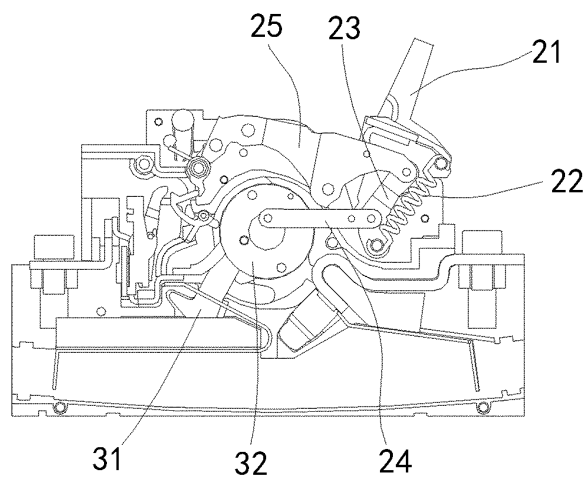


FIG.40

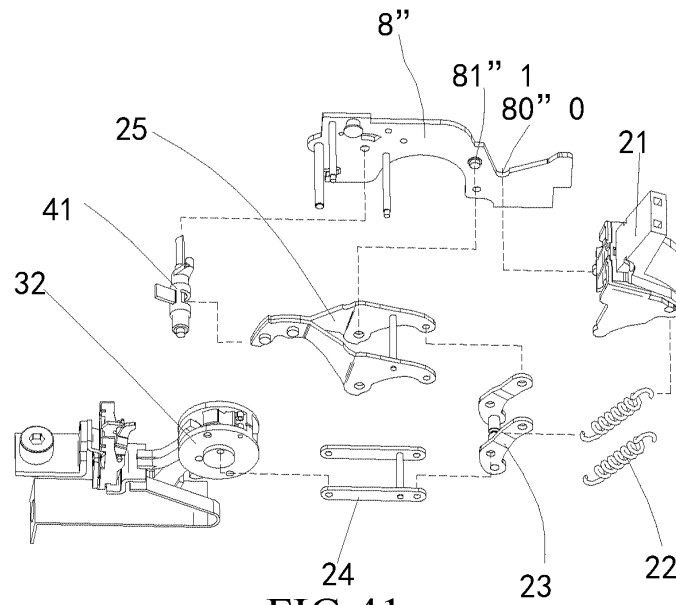


FIG.41

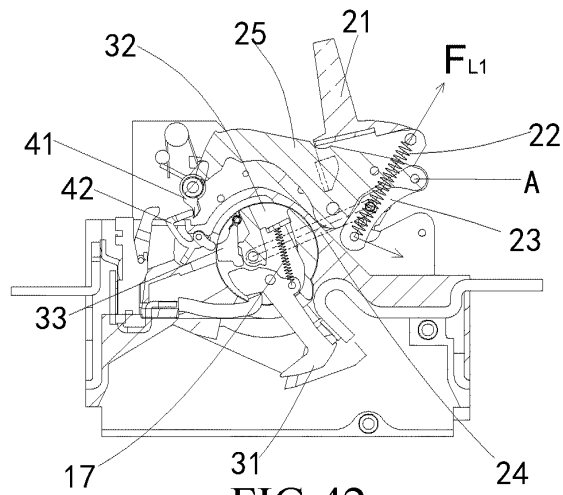


FIG.42

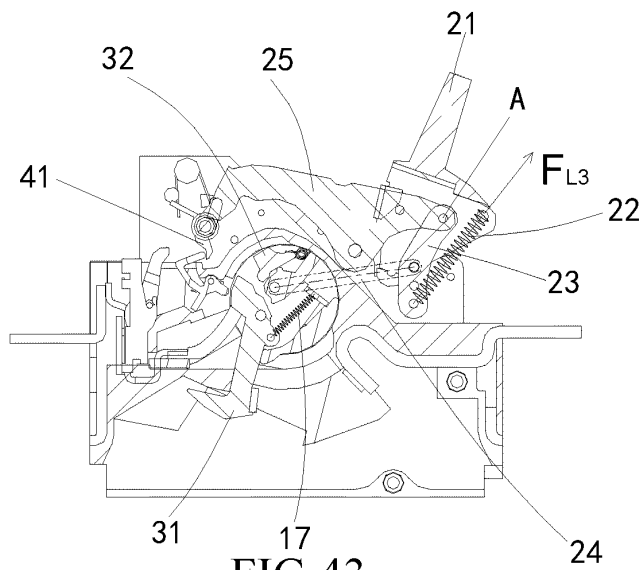


FIG.43

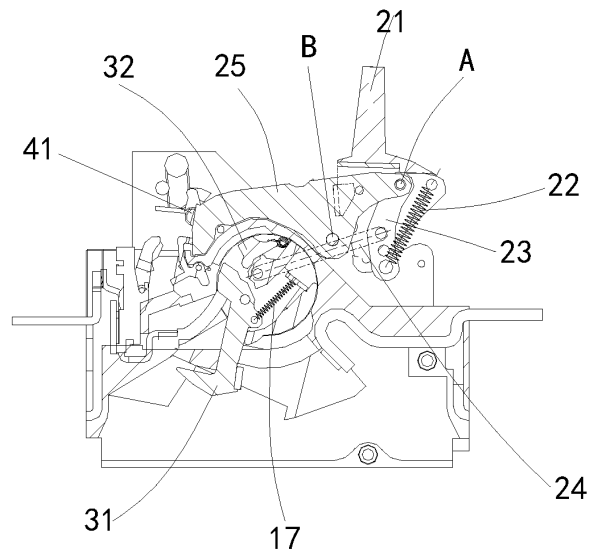


FIG. 44

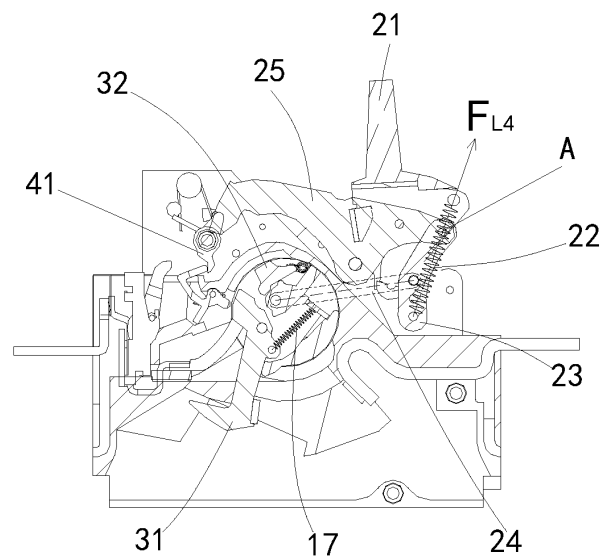


FIG. 45

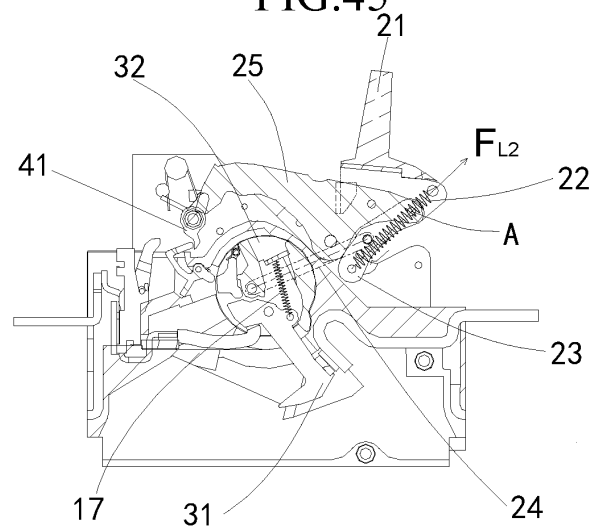
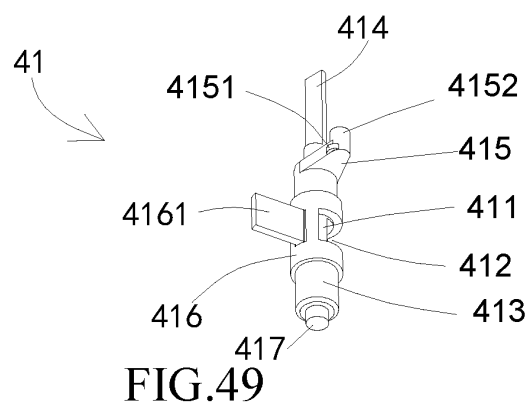
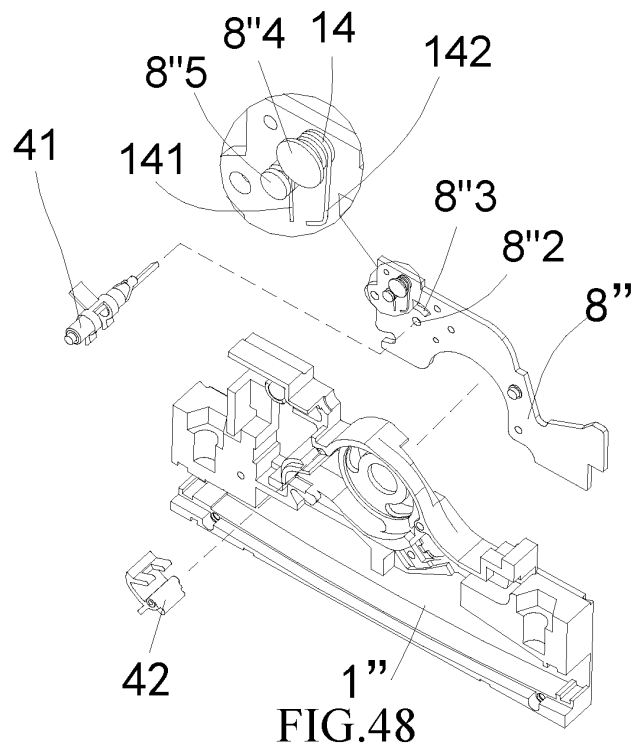
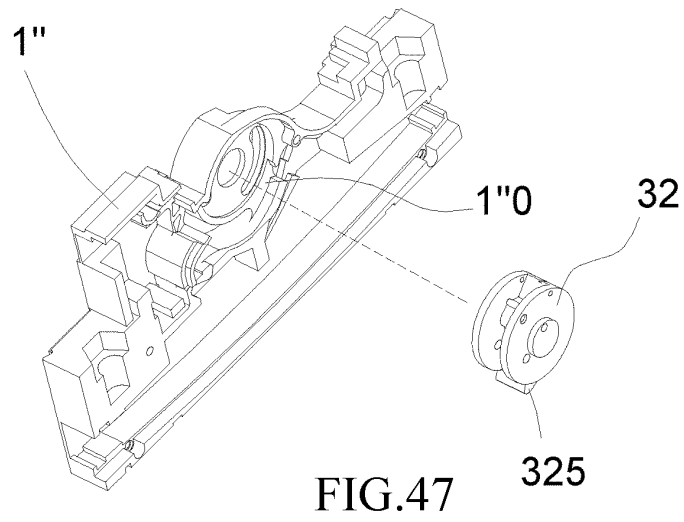


FIG. 46



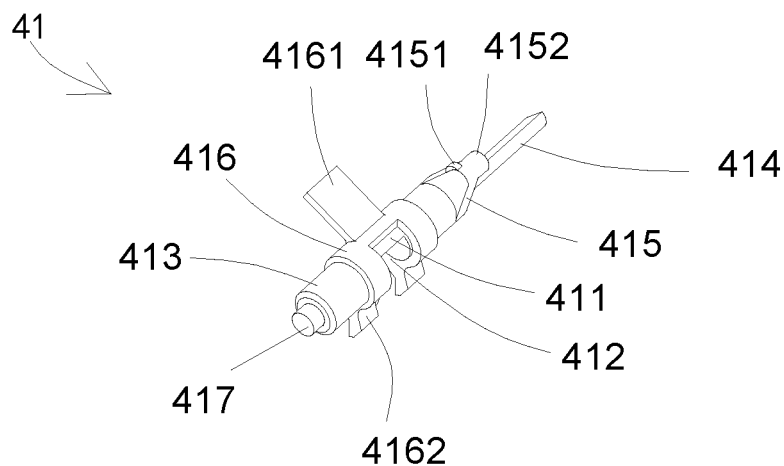


FIG.50

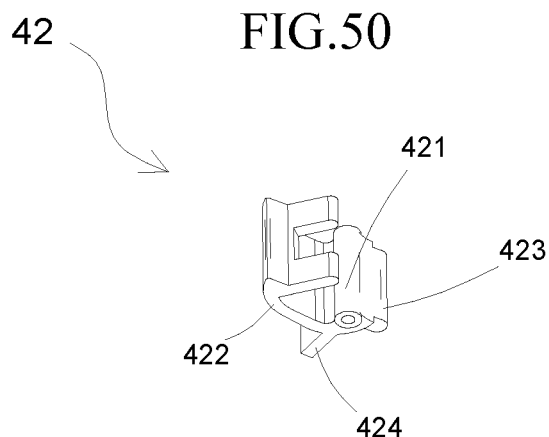


FIG.51

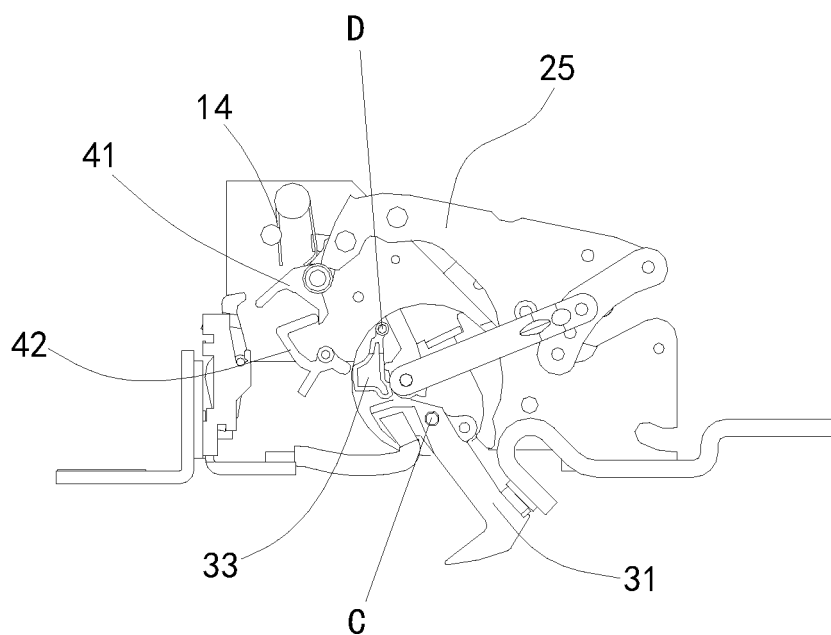


FIG.52

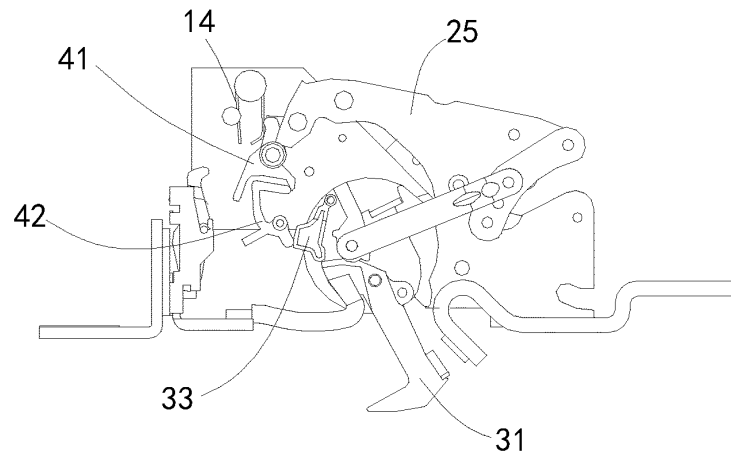


FIG. 53

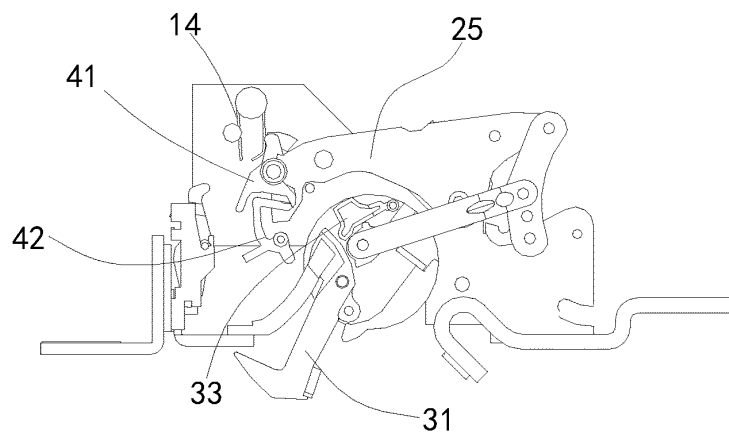


FIG. 54

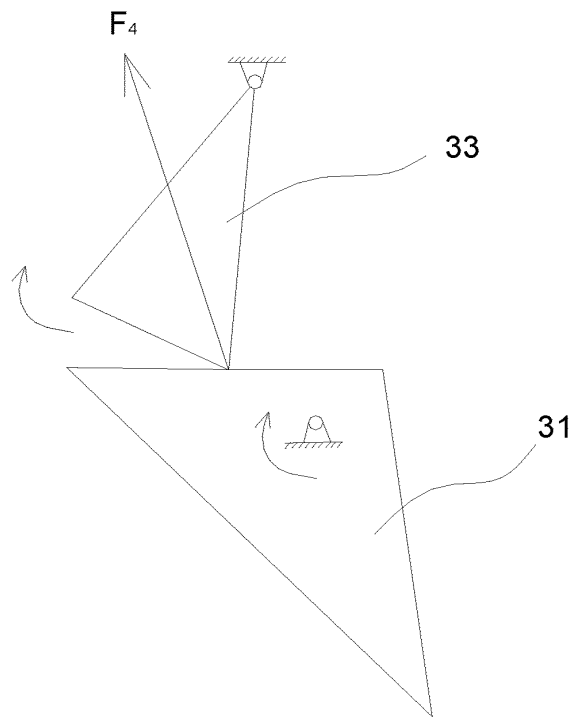


FIG. 55

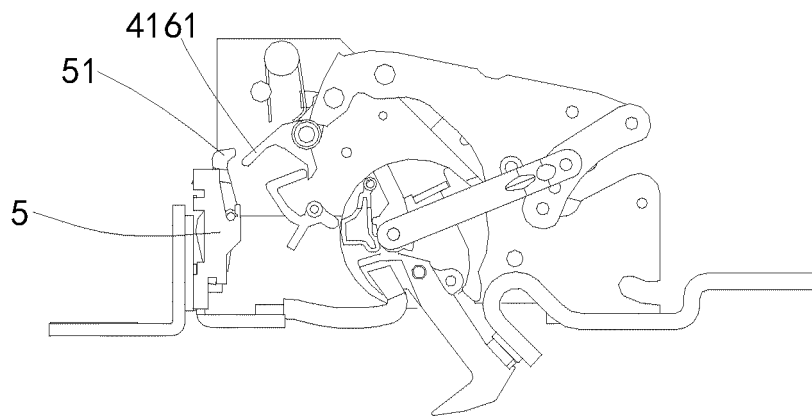


FIG. 56

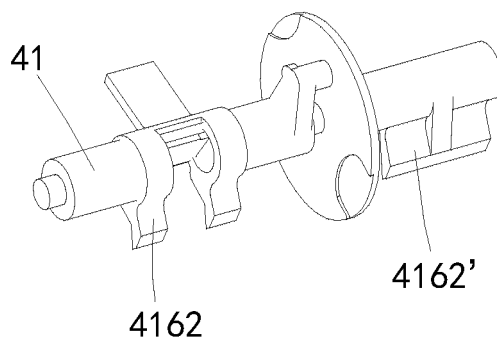


FIG. 57

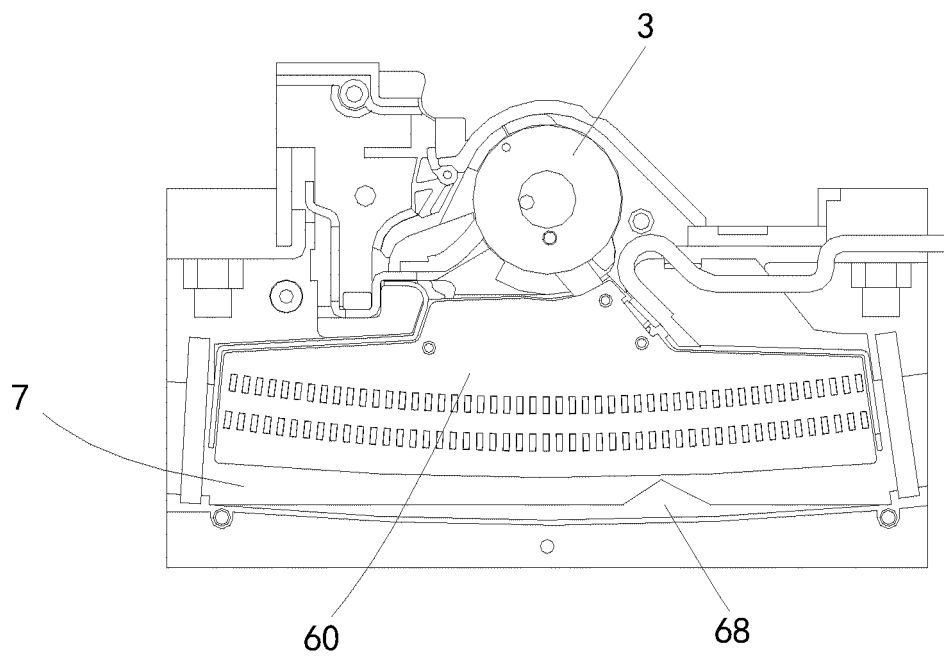
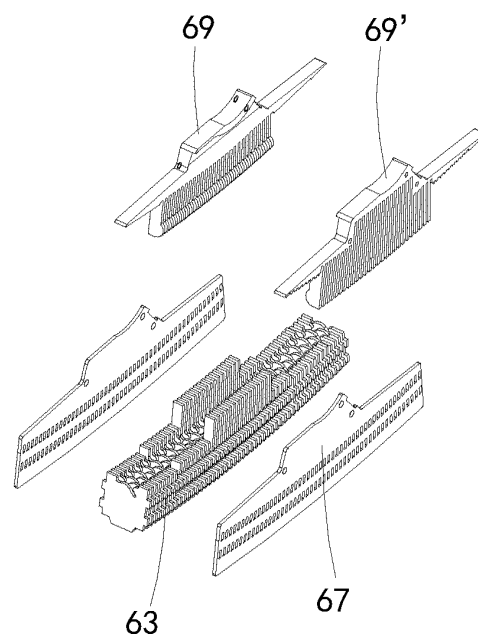
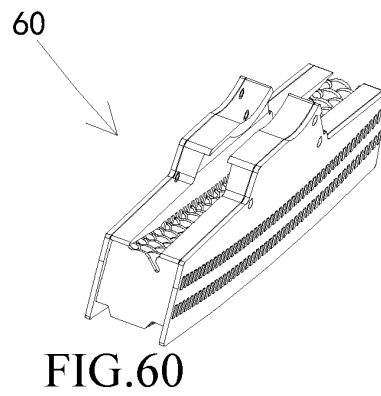
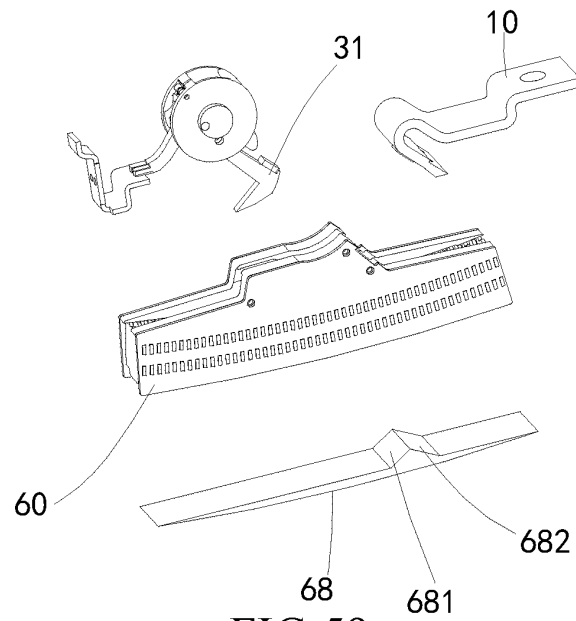


FIG. 58



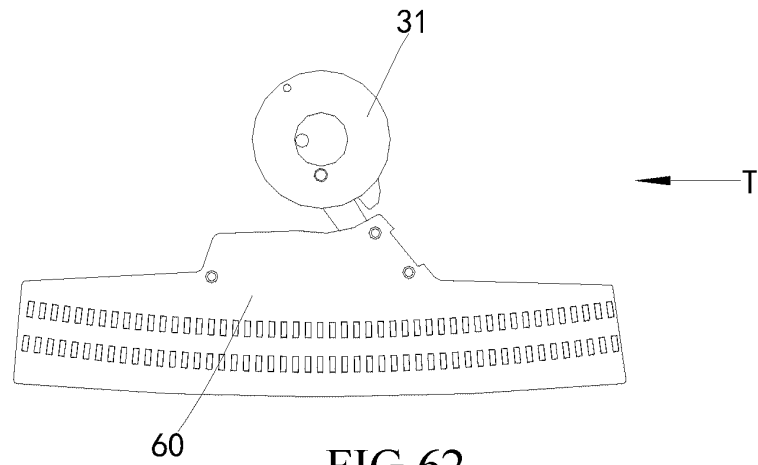


FIG. 62

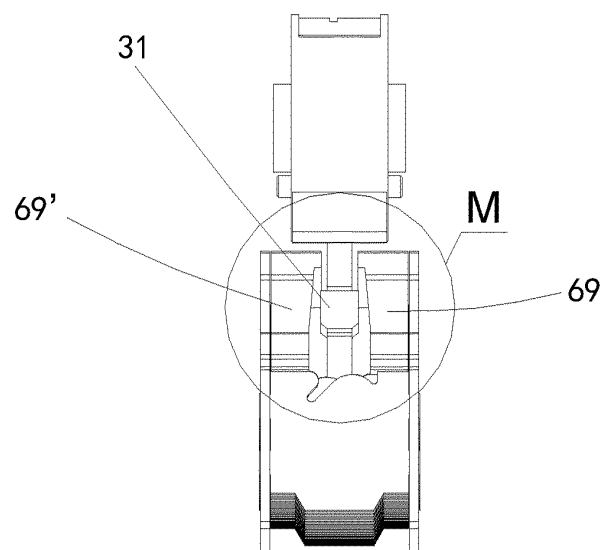


FIG. 63

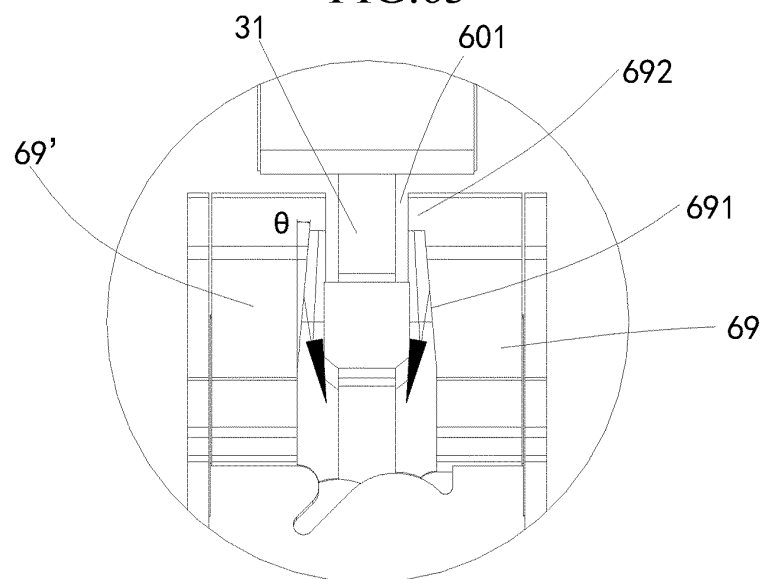


FIG. 64

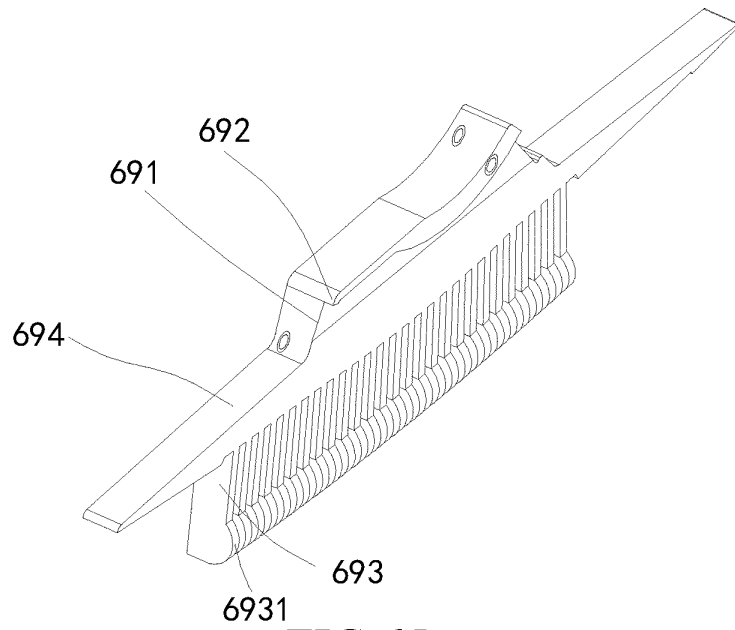


FIG. 65

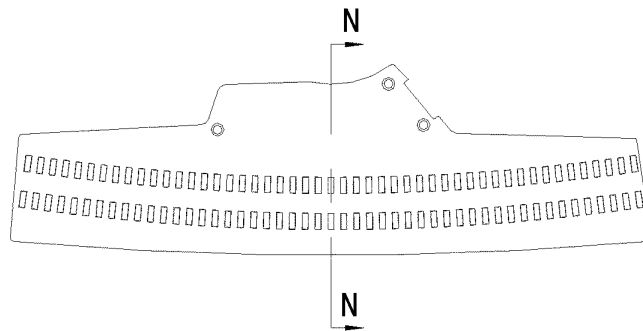


FIG. 66

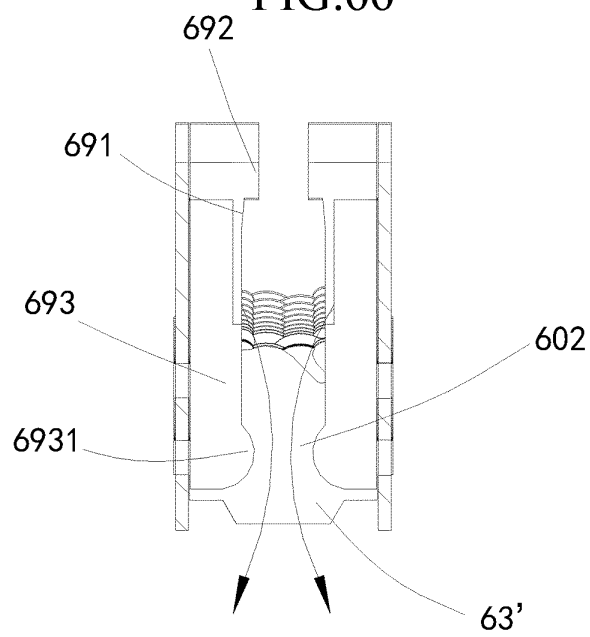


FIG. 67

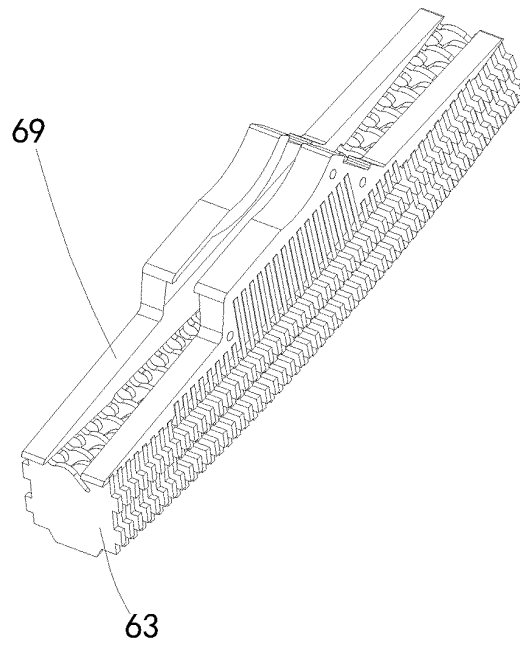


FIG. 68

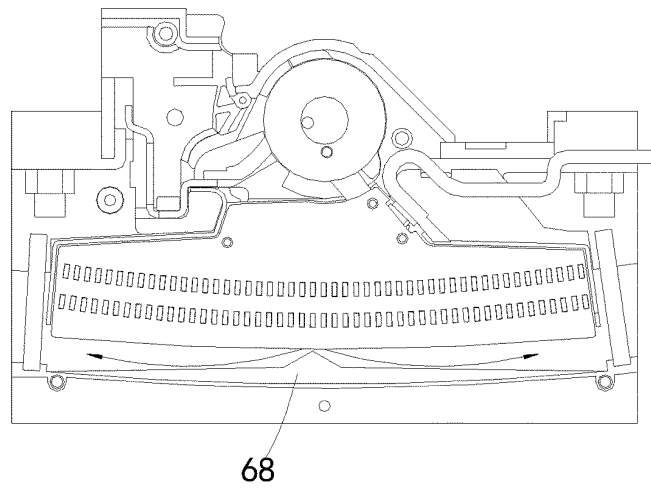


FIG. 69

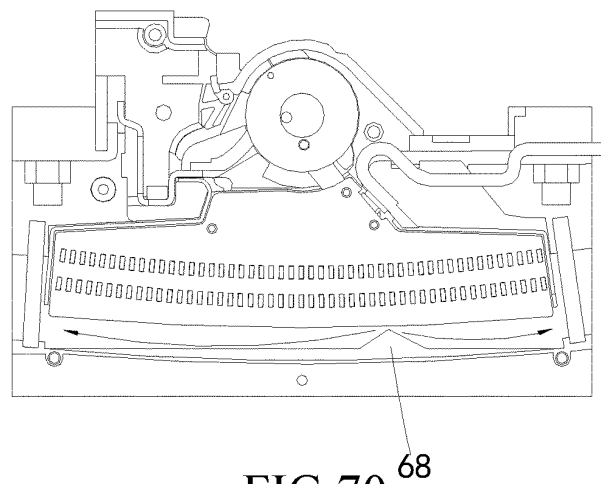


FIG. 70⁶⁸

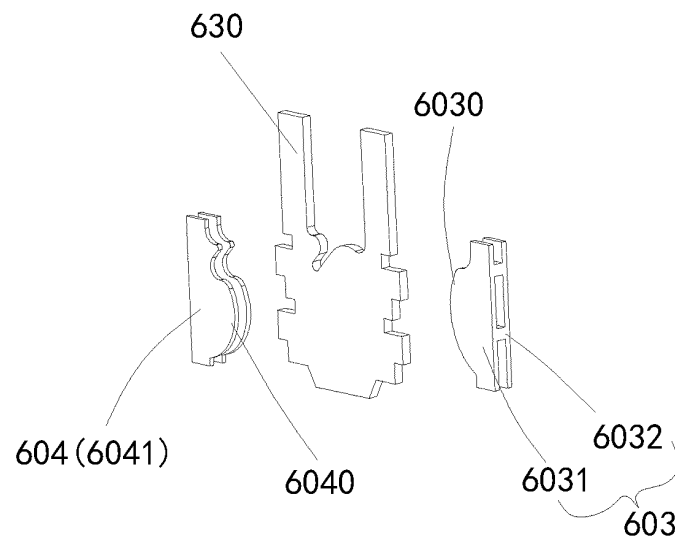


FIG. 71

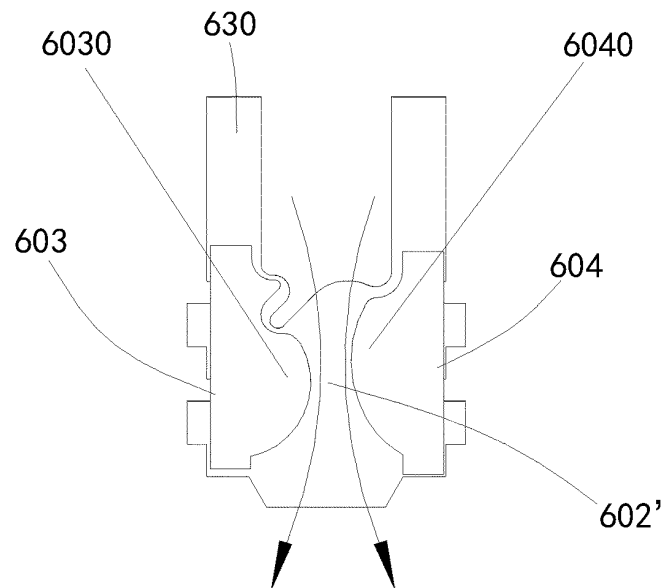


FIG. 72

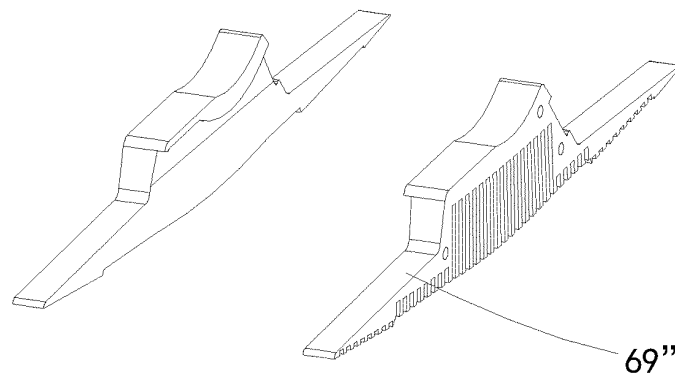


FIG. 73

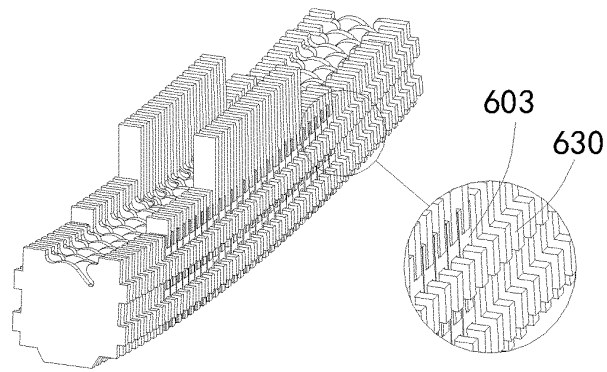


FIG. 74

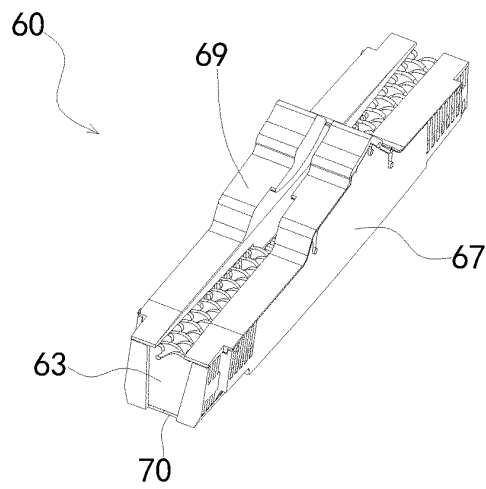


FIG. 75

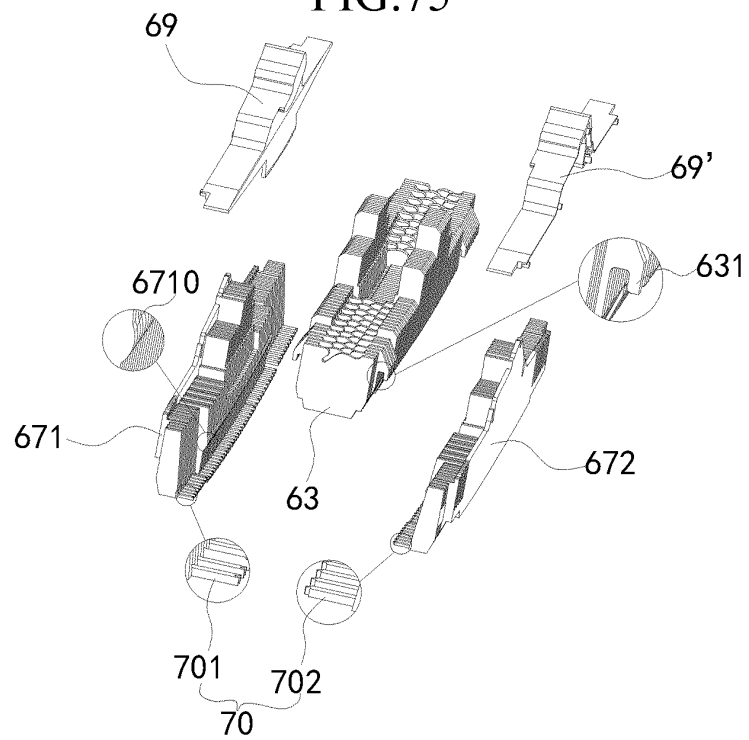


FIG. 76

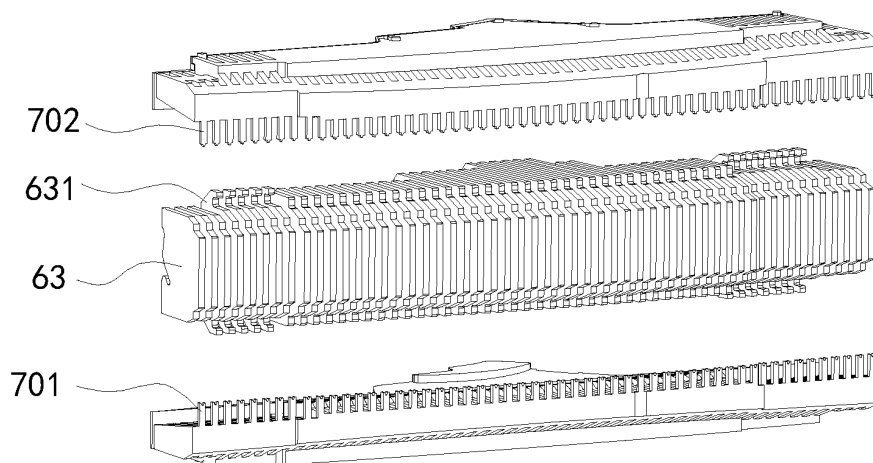


FIG. 77

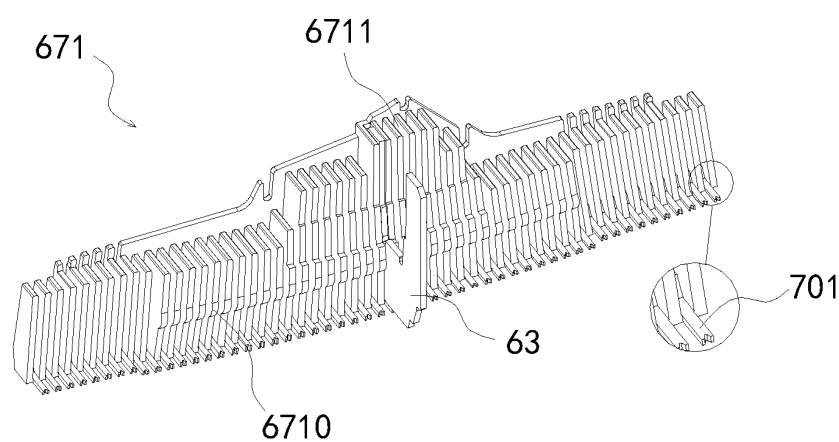


FIG. 78

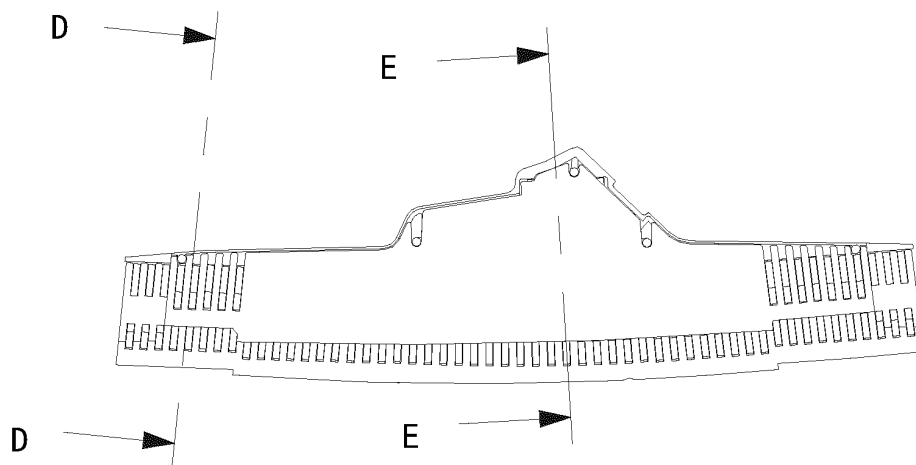


FIG. 79

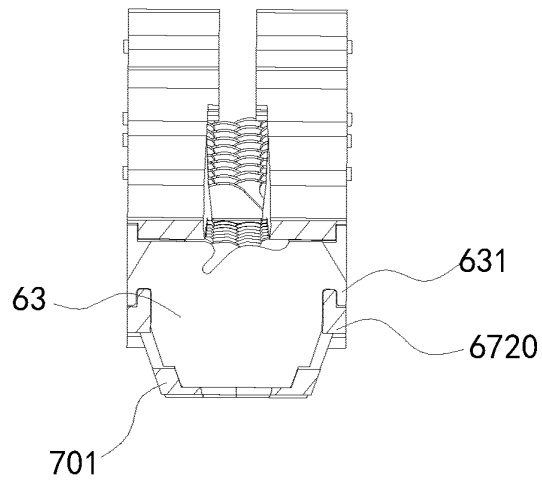


FIG.80

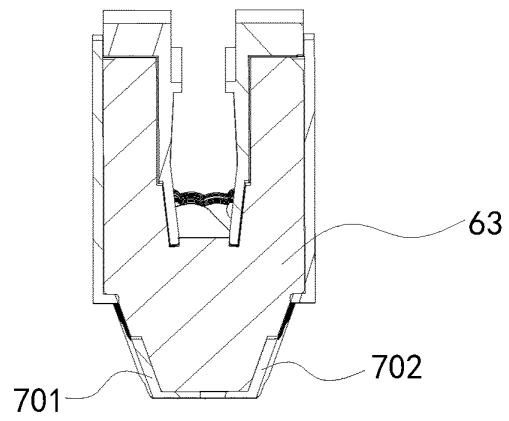


FIG.81

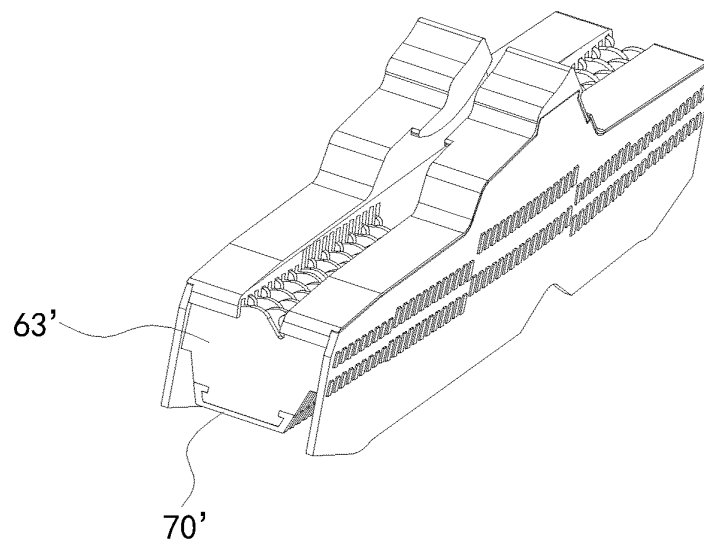


FIG.82

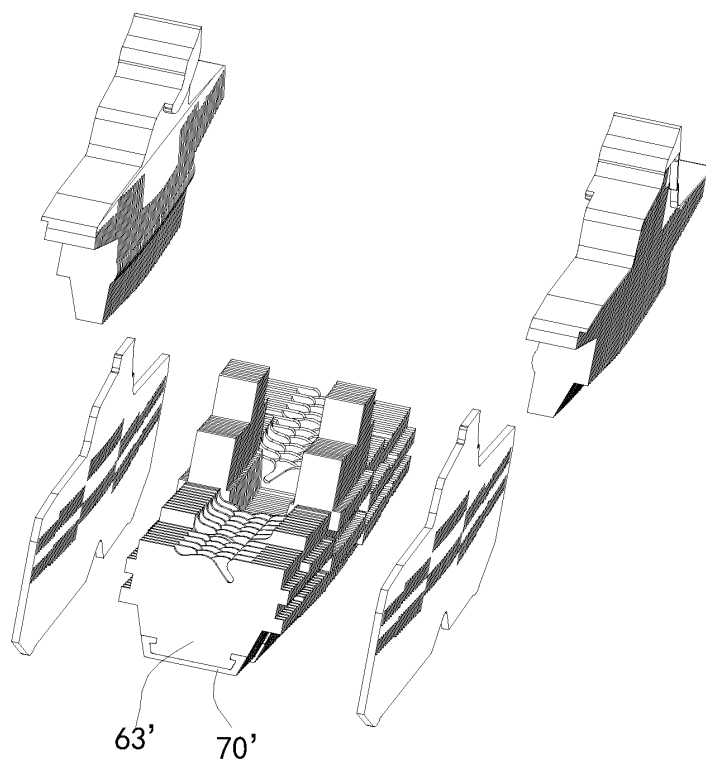


FIG. 83

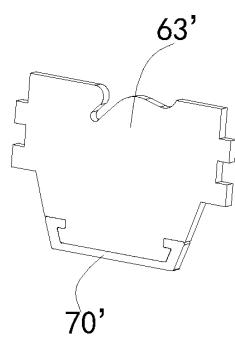


FIG. 84

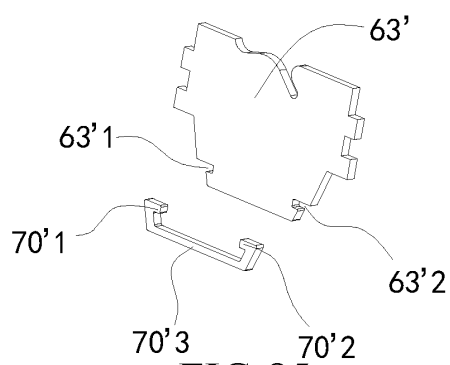


FIG. 85

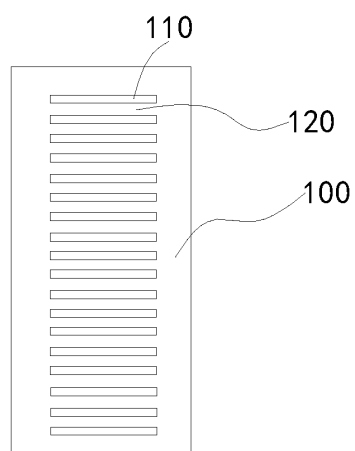


FIG. 86

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/105581

A. CLASSIFICATION OF SUBJECT MATTER H01H 33/664(2006.01)i; H01H 33/666(2006.01)i 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) H01H Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNABS; CNTXT; CNKI; SIPOABS; DWPI; USTXT; WOTXT; EPTXT; 脱扣, 锁扣, 触头, 触点, 灭弧, 下方, 下侧, 跳扣, 连杆, 最大, 最长, 增磁, 复位, 拉瓦尔喷嘴, 导流, 分流, 绝缘, 多极, 厦门宏发开关设备有限公司, 上海电器科学研究所, tripping, lock+, contact+, arc 1d extinguish+, reposit+, insulat+, jump+ buckle																		
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>PX</td> <td>CN 111834163 A (XIAMEN HONGFA ELECTRICAL SAFETY & CONTROLS CO., LTD.) 27 October 2020 (2020-10-27) description, paragraphs [0075]-[0116], and figures 1-57</td> <td>1-26, 47, 48</td> </tr> <tr> <td>PX</td> <td>CN 111834164 A (XIAMEN HONGFA ELECTRICAL SAFETY & CONTROLS CO., LTD.) 27 October 2020 (2020-10-27) description, paragraphs [0046]-[0064], and figures 1-24</td> <td>1-5, 7-17</td> </tr> <tr> <td>PX</td> <td>CN 111834162 A (XIAMEN HONGFA ELECTRICAL SAFETY & CONTROLS CO., LTD.) 27 October 2020 (2020-10-27) description, paragraphs [0052]-[0070], and figures 1-29</td> <td>1, 3-6, 18-26</td> </tr> <tr> <td>PX</td> <td>CN 111834161 A (XIAMEN HONGFA ELECTRICAL SAFETY & CONTROLS CO., LTD.) 27 October 2020 (2020-10-27) description, paragraphs [0061]-[0091], and figures 1-39</td> <td>1-5, 7-17</td> </tr> <tr> <td>X</td> <td>CN 108695124 A (SHANGHAI ELECTRICAL APPARATUS RESEARCH INSTITUTE (GROUP) CO., LTD.) 23 October 2018 (2018-10-23) description, paragraphs [0005]-[0033], and figures 5-13</td> <td>1, 3, 4, 47, 48</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	PX	CN 111834163 A (XIAMEN HONGFA ELECTRICAL SAFETY & CONTROLS CO., LTD.) 27 October 2020 (2020-10-27) description, paragraphs [0075]-[0116], and figures 1-57	1-26, 47, 48	PX	CN 111834164 A (XIAMEN HONGFA ELECTRICAL SAFETY & CONTROLS CO., LTD.) 27 October 2020 (2020-10-27) description, paragraphs [0046]-[0064], and figures 1-24	1-5, 7-17	PX	CN 111834162 A (XIAMEN HONGFA ELECTRICAL SAFETY & CONTROLS CO., LTD.) 27 October 2020 (2020-10-27) description, paragraphs [0052]-[0070], and figures 1-29	1, 3-6, 18-26	PX	CN 111834161 A (XIAMEN HONGFA ELECTRICAL SAFETY & CONTROLS CO., LTD.) 27 October 2020 (2020-10-27) description, paragraphs [0061]-[0091], and figures 1-39	1-5, 7-17	X	CN 108695124 A (SHANGHAI ELECTRICAL APPARATUS RESEARCH INSTITUTE (GROUP) CO., LTD.) 23 October 2018 (2018-10-23) description, paragraphs [0005]-[0033], and figures 5-13	1, 3, 4, 47, 48
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PX	CN 111834164 A (XIAMEN HONGFA ELECTRICAL SAFETY & CONTROLS CO., LTD.) 27 October 2020 (2020-10-27) description, paragraphs [0046]-[0064], and figures 1-24	1-5, 7-17																
PX	CN 111834162 A (XIAMEN HONGFA ELECTRICAL SAFETY & CONTROLS CO., LTD.) 27 October 2020 (2020-10-27) description, paragraphs [0052]-[0070], and figures 1-29	1, 3-6, 18-26																
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Date of the actual completion of the international search 07 September 2021	Date of mailing of the international search report 27 September 2021																	
Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.																	

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/105581

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 108695124 A (SHANGHAI ELECTRICAL APPARATUS RESEARCH INSTITUTE (GROUP) CO., LTD.) 23 October 2018 (2018-10-23) description, paragraphs [0027]-[0033], and figures 5-13	2, 5-46
A	DE 102017202370 A1 (SIEMENS AKTIENGESELLSCHAFT) 16 August 2018 (2018-08-16) entire document	1-48

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	111834163	A	27 October 2020	CN	213716792	U	16 July 2021
CN	111834164	A	27 October 2020	CN	212676173	U	09 March 2021
CN	111834162	A	27 October 2020	CN	213400993	U	08 June 2021
CN	111834161	A	27 October 2020	CN	212461514	U	02 February 2021
CN	108695124	A	23 October 2018	CN	208848839	U	10 May 2019
DE	102017202370	A1	16 August 2018	None			

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Patent documents cited in the description

- CN 108695124 A [0002]
- CN 205282331 U [0096]