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(54) **MINIATURE CIRCUIT BREAKER**

(57) A miniature circuit breaker comprises a housing having an air outlet. A plurality of arc extinguishing grid-plates is mounted in an arc extinguishing chamber. The arc extinguishing chamber is fixedly connected to the housing. An air discharge opening is formed in a rear plate of the arc extinguishing chamber. A rear arc extinguishing structure is disposed between the air discharge opening of the arc extinguishing chamber and the air outlet of the housing. The rear arc extinguishing structure comprises a plurality of air flow passages disposed between the air discharge opening of the arc extinguishing chamber and the air outlet of the housing, such that high-temperature air flows in the arc extinguishing chamber pass through the air discharge opening and the plurality of air flow passages and are then discharged from the air outlet. Thus, the air flows flowing out from the grid-plates of the arc extinguishing chamber can be prevented from interfering with each other, hot air flows can be prevented from interfering with each other at the air outlet, and heat energy can be quickly dissipated, thereby quickly extinguishing electric arcs, enhancing an arc extinguishing effect of an arc extinguishing system and a breaking capability of the circuit breaker, and reducing the volume of the arc extinguishing chamber.

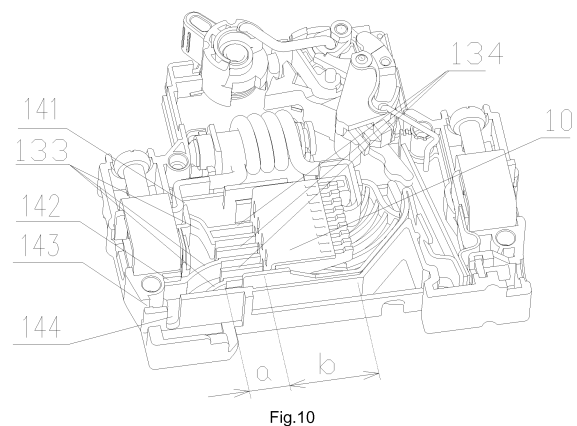


Fig.10

**EP 3 439 015 A1**

## Description

### TECHNICAL FIELD

**[0001]** The utility model belongs to the field of low-voltage apparatuses, in particular to a miniature circuit breaker.

### BACKGROUND

**[0002]** An arc extinguishing system of a miniature circuit breaker generally comprises an arc extinguishing chamber and an arc runner which are composed of arc extinguishing grid-plates, and an arc blowing device configured to guide an electric arc to the arc extinguishing chamber. In particular for a conventionally used miniature circuit breaker with an alternating current of 50Hz, a rated current up to 63A and a rated voltage not exceeding 400V, an arc extinguishing capability of the arc extinguishing system is associated with a breaking capability of the circuit breaker, and the arc extinguishing capability also involves many factors. According to the existing miniature circuit breaker, a plurality of arc extinguishing grid-plates are manufactured into an arc extinguishing chamber of an integrated structure firstly, and then the arc extinguishing chamber is mounted into the circuit breaker. In this way, there are many problems arising: firstly, the arc extinguishing chamber of the integrated structure is inconvenient to process and high in manufacturing cost; secondly, the structure of the arc extinguishing chamber is single, and the same type of arc extinguishing chamber may be used only regardless of the current specification, which cannot meet different arc extinguishing requirements of different types of circuit breaker products, thereby affecting the performances of the circuit breaker product; for example, the use of a large arc extinguishing chamber for a small-sized product will affect the miniaturization requirement, and the use of a small arc extinguishing chamber for a large-sized product will affect the breaking capability; thirdly, a high-temperature airflow in the arc extinguishing chamber cannot be discharged smoothly, this is because the structure of the arc extinguishing chamber causes that air discharge openings behind the arc extinguishing chamber cannot be made to be large, thereby affecting an arc extinguishing effect.

**[0003]** At the same time, the design of an arc extinguishing system of the existing circuit breaker focuses on an arc extinguishing chamber and front structures in front thereof, such as an arc striking structure and an arc blowing structure, but the discharge of high temperature airflow in the arc extinguishing chamber is generally ignored. However, it has been found through experiments that the discharge of the high-temperature airflow is essential for the arc extinguishing effect, in which the rear structures, such as an air discharge opening behind the arc extinguishing chamber, an air outlet in a housing, and an air flow passage between the air discharge opening

of the arc extinguishing chamber and the air outlet of the housing are involved. The rear structures have the adverse effect mainly in that: since the hot air flows ejected by the electric arc after passing through the arc extinguishing chamber form mutual interference at the air discharge opening, the discharge of the hot air flows is not smooth, thereby affecting the arc extinguishing effect of the circuit breaker. Therefore, people use the existing miniature circuit breaker equipped with a large-sized arc extinguishing chamber. However, since the arc extinguishing chamber is composed of a plurality of arc extinguishing grid-plates, the volume of the arc extinguishing chamber is increased to make the structure of the arc extinguishing chamber complicated, thereby increasing the processing cost and not conforming to the miniaturization design trend of the miniature circuit breaker. Moreover, the optimal arc extinguishing effect and the optimal breaking capability of the circuit breaker cannot be obtained owing to the pressure of the hot air flow in case where air cannot be discharged smoothly, such that the impact damage to the arc extinguishing system including the arc extinguishing chamber is aggravated. In order to strengthen the impact resistance of the arc extinguishing system, the complexity of the arc extinguishing structure and the increase of the manufacturing cost are also caused.

### SUMMARY

**[0004]** The technical problem to be solved by the utility model is to provide a miniature circuit breaker with respect to the defects that arc striking and air discharging effects of the hot air flow at the air discharge opening of the above-mentioned arc extinguishing chamber are poor and can be remedied only by increasing the volume of the air extinguishing chamber in the prior art. By adopting a plurality of air flow passages disposed between an air outlet and the arc extinguishing chamber, an optimal arc extinguishing effect and an optimal breaking capability can be obtained, and the volume of the arc extinguishing chamber can be appropriately reduced.

**[0005]** A miniature circuit breaker comprises a housing having an air outlet, wherein a plurality of arc extinguishing grid-plates is mounted in an arc extinguishing chamber 10; the arc extinguishing chamber 10 is fixedly connected to the housing; an air discharge opening 101 is formed in a rear plate of the arc extinguishing chamber 10; a rear arc extinguishing structure is disposed between the air discharge opening 101 of the arc extinguishing chamber 10 and the air outlet of the housing; the rear arc extinguishing structure comprises a plurality of air flow passages disposed between the air discharge opening 101 of the arc extinguishing chamber 10 and the air outlet of the housing, such that high-temperature air flows in the arc extinguishing chamber 10 pass through the air discharge opening 101 and the plurality of air flow passages and are then discharged from the air outlet.

**[0006]** Preferably, the air flow passages of the rear arc

extinguishing structure comprises a exhaust passage 132 and a plurality of guide passages 131; each guide passage 131 is communicated with at least one air discharge opening 101 and at least one exhaust passage 132; the exhaust passage 132 is communicated with the air outlet.

[0007] Preferably, the rear arc extinguishing structure comprises a plurality of guide passages 131, wherein the plurality of guide passages 131 are in one-to-one correspondence with the plurality of air discharge openings 101 behind the arc extinguishing chamber 10.

[0008] Preferably, the rear arc extinguishing structure comprises a plurality of guide passages 131 and a plurality of exhaust passages 132, where the number of the exhaust passages 132 is less than that of the guide passages 131; the plurality of guide passages 131 are in one-to-one correspondence with the plurality of air discharge openings 101 behind the arc extinguishing chamber 10; each exhaust passage 132 is communicated with at least one guide passage 131 and at least one air outlet.

[0009] Preferably, the plurality of guide passages 131 is formed by partitioning with a plurality of horizontal partitioning ribs 134; the plurality of horizontal partitioning ribs 134 are disposed in parallel with the arc extinguishing grid-plates to form a grid-type heat dissipation structure.

[0010] Preferably, the air flow passages of the rear arc extinguishing structure are a plurality of guide passages 131 which are disposed between the air discharging openings 101 of the arc extinguishing chamber 10 and the air outlets of the housing and partitioned by arc-shaped partitioning ribs 133.

[0011] Preferably, a ratio of a length of each guide passage 131 of the rear arc extinguishing structure to a length of the arc extinguishing chamber 10 is 0.2 to 0.5.

[0012] Preferably, a plurality of arc extinguishing grid-plates is disposed in the arc extinguishing chamber 10; an arc extinguishing gap is formed between every two adjacent arc extinguishing grid-plates; a plurality of air discharge openings 101 is formed in the rear plate of the arc extinguishing chamber 10; each air discharge opening is in one-to-one correspondence with one arc extinguishing gap; the plurality of air discharge openings 101 in the rear plate of the arc extinguishing chamber 10 are disposed on two sides of the rear plate in two columns; the two columns of air discharge openings 101 are alternately disposed in staggered layers.

[0013] Preferably, four air outlets are formed in one side of the housing, i.e., a first air outlet 141 close to the top of a wiring base of a wiring terminal at one side of the housing, a second air outlet 142 close to the bottom of the wiring base, as well as a third air outlet 143 and a fourth air outlet 144 which are positioned on the sidewall and the bottom edge of the bottom of one side of the housing respectively; a space between the exhaust passages 132 and the four air outlets is partitioned by three arc-shaped partitioning ribs 133 to form four guide passages 131 which are in one-to-one correspondence with the four air outlets, wherein a ventilation space is pre-

served at the end part of the arc-shaped partitioning rib 133 that isolates the third air outlet 143 from the fourth air outlet 144, such that the third air outlet 143 is communicated with the fourth air outlet 144.

[0014] Preferably, the miniature circuit breaker further comprises a front arc extinguishing structure disposed in the housing; the front arc extinguishing structure comprises a plurality of arc striking grooves which is disposed between an opening in the front side of the arc extinguishing chamber and a static contact.

[0015] When the miniature circuit breaker is implemented, the air flows flowing out from the grid-plates of the arc extinguishing chamber can be prevented from interfering with each other by disposing a plurality of air flow passages in front of the air outlets of the circuit breaker and behind the arc extinguishing chamber, hot air flows can be prevented from interfering with each other at the air discharge openings, and heat energy can be quickly dissipated, thereby quickly extinguishing electric arcs, enhancing an arc extinguishing effect of an arc extinguishing system and a breaking capability of the circuit breaker, and reducing the volume of the arc extinguishing chamber.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The present utility model will be further described below with reference to the accompanying drawings and embodiments, and the advantages and features of the present utility model can be seen clearly from the description of the embodiments shown in the accompanying drawings. In the drawings,

Fig. 1 is a perspective view showing an internal overall structure of a miniature circuit breaker of the utility model, in which a fixed structure of arc extinguishing grid-plates 2 and a base 1 is shown.

Fig. 1 is a perspective view of a grid-plate fixing structure A, a rear arc extinguishing structure B and a front arc striking structure C in the embodiment shown in Fig. 1.

Fig. 3 is a plan view of Fig. 1.

Fig. 4 is a plan view of Fig. 2.

Fig. 5 is a perspective view of the arc extinguishing grid-plates 2 in the embodiment shown in Fig. 1.

Fig. 6 is a perspective view of a housing cover 6.

Fig. 7 is an enlarged view of a part E in Fig. 2.

Fig. 8 is an enlarged view of a part F in Fig. 6.

Figs. 9-10 illustrate another embodiment of the utility model.

Fig. 11 is a perspective view of an arc extinguishing chamber in Fig. 9.

## DETAILED DESCRIPTION

[0017] As can be seen from the perspective view of the overall internal structure of the miniature circuit breaker shown in Fig. 1 and the perspective view of the housing

cover 6 shown in Fig. 6, the miniature circuit breaker provided with multi-positioned arc extinguishing grid-plates of the utility model comprises a housing composed of a base 1 and the housing cover 6. The base 1 and the housing cover 6 can be statically connected by any known means (such as screws, snaps, etc.). A static contact 3 and a movable contact 4 are disposed in a cavity formed between the base 1 and the housing cover 6. A handle drives the movable contact 4 to swing by an operating mechanism 7 to be in contact with and to be separated from the static contact 3 to realize the on/off of a circuit.

**[0018]** The circuit breakers belong to products with different sizes and different current specifications according to users' demands, wherein the demands for arc extinguishing systems are different. The miniature circuit breaker provided with multi-positioned arc extinguishing grid-plates of the utility model has a beneficial effect: the housing is provided with a grid-plate fixing structure A for fixing the arc extinguishing grid-plates 2, and the arc-extinguishing grid-plates 2 are directly and statically connected to the housing through the grid-plate fixing structure A, such that a gap 2a which is communicated with an air outlet in the housing is formed between every two adjacent arc extinguishing grid-plates 2. By disposing the grid-plate fixing structure A, it is possible to dispose different numbers of arc extinguishing grid-plates according to different current specifications, without the need of making the arc extinguishing chamber integral, thereby facilitating processing and optimizing the structures of the products. The arc-extinguishing grid-plates 2 are directly and statically connected to the base 1 and the housing cover 6 respectively through the grid-plate fixing structure A, such that a plurality of gaps 2a is formed between every two adjacent arc extinguishing grid-plates 2 by means of the static connection. The term "multi-positioned" as described herein means that the number of arc extinguishing grid-plates 2 may be determined according to different arc extinguishing requirements of different types of circuit breaker products. In addition, by directly and statically connecting the arc extinguishing grid-plates to the base 1 and the housing cover 6 respectively, the arc extinguishing grid-plates 2 may be directly fixed on the base 1 and the housing cover 6, without using an existing arc extinguishing structure in which a plurality of arc extinguishing grid-plates are fixedly connected together by plate-wall-type elements constituting an arc extinguishing chamber and without adjusting the housing. It is apparent that, to realize the diversification of the number of the arc extinguishing grid-plates 2, the key is to use the multi-positioned arc extinguishing grid-plates 2 and the grid-plate fixing structure A, thereby achieving the beneficial effects including: the problem that the arc extinguishing chamber is too large or too small can be effectively overcome, and the excellent arc extinguishing effect is ensured while the miniaturization requirement is satisfied.

**[0019]** In order to improve the arc extinguishing effect

of the utility model, the miniature circuit breaker of the utility model further comprises a rear arc extinguishing structure B and a front arc extinguishing structure C which are disposed inside the housing. The rear arc extinguishing structure B comprises a plurality of air flow passages 13a, 13b, 13c disposed between the gap 2a between every two of the arc extinguishing grid-plates 2 on the grid-plate fixing structure A and the air outlet, such that high-temperature air flows in the gaps 2a are guided through the plurality of air flow passages 13a, 13b, 13c and then discharged from the air outlet. The front arc striking structure C comprises a plurality of arc striking grooves 16 disposed between the arc extinguishing grid-plates 2 on the grid-plate fixing structure A and the static contact. As shown in Figs. 1-4, an instantaneous tripper including an electromagnetic trip device 8 and an overload tripper including a bimetal sheet 9 are also disposed in the housing of the miniature circuit breaker of this embodiment. A striker of the electromagnetic trip device 8 corresponds to a lock catch of the operating mechanism. The bimetal sheet 9 corresponds to a driving rod (not shown in drawings) extending out from the lock catch. When the electric leakage occurs, the striker of the electromagnetic trip device 8 pops up and hits the lock catch of the operating mechanism to trip the circuit breaker; when the circuit is overloaded, the bimetal sheet is bent to pull the lock catch through the driving rod to trip the circuit breaker. The grid-plate fixing structure A for fixing the arc extinguishing grid-plates 2 is disposed below the electromagnetic trip device 8, and the rear arc extinguishing structure B and the front arc striking structure C are respectively disposed on both sides of the grid-plate fixing structure A. The static contact 3 having an arc striking structure and an arc striking plate 5 having a V-shaped arc striking angle are respectively disposed above and below the side, close to the front arc striking structure C, of the grid-plate fixing structure A. The movable contact 3 is connected to a coil of the electromagnetic trip device 8. The arc striking plate 5 is connected to the bimetal sheet 9. By means of the arc striking structures, an electric arc can be guided to the arc extinguishing grid-plates 2 rapidly, then a high temperature gas can be discharged rapidly by means of the rear arc extinguishing structure B and the air outlet, and therefore the arc extinguishing effect and the breaking capability can be effectively improved.

**[0020]** The miniature circuit breaker of the utility model has another beneficial effect: there are a plurality of manners for the grid-plate fixing structure, wherein one preferred manner is as shown in Figs. 2 and 4: the grid-plate fixing structure A comprises a plurality of lower fixing grooves 15 formed in the base 1 and a plurality of upper fixing grooves 65 formed in the housing cover 6 (refer to Figs. 6 and 8), wherein a lower edge 21 (refer to Fig. 5) of each arc extinguishing grid-plate 2 is fixedly embedded in each lower fixing groove 15, an upper edge (refer to Fig. 5) of each arc extinguishing grid-plate 2 is fixedly embedded in each upper fixing groove 65, such that each

arc extinguishing grid-plate 2 is directly and statically connected to the base 1 and the housing cover 6 by means of the fixed embedding. There are a plurality of manners for the lower fixing grooves 15 and the upper fixing grooves 65, wherein one preferred manner is as shown in Figs. 2 to 8: the base 1 is provided with a plurality of lower fixing ribs 11 (refer to Fig. 7), each lower fixing groove 15 of the grid-plate fixing structure A as shown in Figs. 2 and 4 is formed by a space between every two adjacent lower fixing ribs 11, and a height of each lower fixing rib 11 is far less than a height H of each arc extinguishing grid-plate 2 (refer to Fig. 5); refer to Fig. 6, a plurality of upper fixing ribs 61 is disposed on the housing cover 6, each upper fixing groove 65 of the grid-plate fixing structure A is formed by a space between every two adjacent fixing ribs 61, and a height of each upper fixing rib 61 is far less than the height H of each arc extinguishing grid-plate 2 (refer to Fig. 5). In order to ensure that the static connection for fixed embedding between the arc extinguishing grid-plates 2 and the lower fixing grooves 15 as well as between the arc extinguishing grid-plates 2 and the upper fixing grooves 65 is not loose under the impact of the high temperature airflow and also ensure that the gap 2a has a sufficiently large remaining height (this height is equal to the height H of each arc extinguishing grid-plate 2 minus the height of the lower edge 21 and the height of the upper edge 22), it is necessary to optimize a dimensional fit between the arc extinguishing grid-plates 2 and the lower fixing grooves 15 as well as between the arc extinguishing grid-plates 2 and the upper fixing grooves 65. There is a plurality of specific manners for optimization, wherein one preferred manner is as follows: a width D1 (refer to Fig. 7) of each lower fixing groove 15 of the grid-plate fixing structure A is equal to a thickness d (refer to Fig. 5) of each arc extinguishing grid-plate 2, and a depth h1 (refer to Fig. 7) of the lower fixing groove

**[0021]** 15 is far less than the height H of the arc extinguishing grid-plate 2. A width D6 (refer to Fig. 8) of each upper fixing groove 65 of the grid-plate fixing structure A is equal to the thickness d of the arc extinguishing grid-plate 2, a length of the upper fixing groove 65 is equal to the length b of the arc extinguishing grid-plate 2, and a depth h6 (refer to Fig. 8) of each lower fixing groove 65 is far less than the height H of the arc extinguishing grid-plate 2. As can be seen from the embodiment shown in Figs. 2 and 7, a height of each lower fixing rib 11 is equal to a depth h1 (refer to Fig. 7) of each lower fixing groove. As can be seen from the embodiment shown in Figs. 6 and 8, the height of each upper fixing rib 61 is equal to the depth h6 (refer to Fig. 8) of each upper fixing groove 65. However, in the actually used grid-plate fixing structure A, the height of each upper fixing rib 61 may be incompletely equal to the depth h6 of each upper fixing groove 65, but as long as the height of each upper fixing rib 61 is far less than the depth h6 of each upper fixing groove 65, the gap 2a can be made to have the largest possible remaining height while ensuring that the static

connection is not loose, because the arc extinguishing effect of the arc extinguishing grid-plates 2 is better as the remaining height increases, and meanwhile, high temperature airflow in the gap 2a flows to the rear arc extinguishing structure B more smoothly. The "far less" refers that: the depth h6 of each lower fixing groove 65 may be less than one sixth of the height H of each arc extinguishing grid-plate 2; the depth h6 of each upper fixing groove 15 may be less than one sixth of the height H of each arc extinguishing grid-plate 2; the height of each upper fixing rib 61 may be less than one sixth of the height H of each arc extinguishing grid-plate 2; the height of each lower fixing rib 11 may be less than one sixth of the height H of each arc extinguishing grid-plate 2.

**[0022]** The present invention has yet another beneficial effect: the miniature circuit breaker provided with the multi-positioned arc extinguishing grid-plates further comprises a rear arc extinguishing structure B disposed in the housing. The rear arc extinguishing structure B comprises a plurality of air flow passages 13a, 13b, 13c disposed between the gap 2a between every two of the arc extinguishing grid-plates 2 on the grid-plate fixing structure A and the air outlet, such that high-temperature air flows in the gaps 2a are guided through the plurality of air flow passages 13a, 13b, 13c and then discharged from the air outlet. There is a plurality of manners for the specific structure of the rear arc extinguishing structure B, wherein a preferred manner is as shown in Figs. 2 and 4: a plurality of lower partitioning ribs 12 is disposed on the base, and a plurality of upper partitioning ribs 62 is disposed on the housing cover 6 (refer to Fig. 6), wherein the upper partitioning ribs 12 are docked with the upper partitioning ribs 62, such that a space between the base 1 and the housing cover 6 is partitioned into a plurality of air flow passages 13a, 13b and 13c of the rear arc extinguishing structure B, and each of the air flow passages 13a, 13b and 13c is communicated with at least one gap 2a between the arc extinguishing ribs 2 and at least one air outlet respectively. The rear arc extinguishing structure B has the following beneficial effects. Firstly, an electric arc is partitioned into arc sections by the plurality of arc extinguishing grid-plates 2 and the gaps 2a there between. Each arc section is quickly extinguished in each gap 2a, and a high temperature and high pressure airflow is formed in the gap 2a. Since the gaps 2a of the arc extinguishing grid-plates 2 are directly communicated with the plurality of airflow passages 13a, 13b and 13c of the rear arc extinguishing structure B, and the airflow passages can increase a large negative pressure space, the high temperature and high pressure airflows in the gaps 2a can be guided into the airflow passages 13a, 13b and 13c in time and quickly, which can effectively improve the arc extinguishing capability of the arc extinguishing grid-plates 2. Secondly, since the high-temperature air flows flowing out from the gaps 2a flow from the plurality of airflow passages 13a, 13b, and 13c to the plurality of air outlets 14 and 64, respectively, and are then discharged out of the base 1 of the circuit breaker,

the high temperature air flows do not interfere with each other during the flowing discharge process, and can be smoothly and quickly discharged from the air outlets regardless of the air pressure of the high temperature air flows. Thirdly, since the plurality of air flow passages 13a, 13b, and 13c are formed by docking the plurality of lower partitioning ribs 12 with the plurality of upper partitioning ribs 62, and the partitioning ribs also have the effect of dissipating heat, the cooling of the high temperature air flows can be effectively accelerated by increasing the partitioning ribs. Fourthly, since the rear arc extinguishing structure B has the characteristics of smooth and rapid air discharging and can effectively alleviate the impact of the airflows, the structure including the arc extinguishing grid-plates 2 is protected from impact damage. Therefore, the utility model can effectively overcome the following defects of the existing arc extinguishing chamber structure: due to the narrow air discharge openings behind the arc extinguishing chamber, the high temperature and high pressure airflows in the arc extinguishing chamber are not easily discharged from the air discharge openings and also cause the mutual interference of air discharge at the air discharge openings, resulting in that high temperature and high pressure air flows remaining in the arc extinguishing chamber, which are difficult to discharge, pose a serious threat to the arc extinguishing effect, such as causing the electric arc to repeatedly reignite.

**[0023]** In order to further improve an effect of draining high temperature and high pressure air flows of the rear arc extinguishing structure B, a preferred structural solution is as shown in Figs. 3 and 4. The housing is internally provided with a plurality of air outlets and a plurality of air flow passages 13a, 13b and 13c. Each of the air flow passages 13a, 13b and 13c is communicated with at least one gap 2a between the arc extinguishing grid-plates 2 and at least one air outlet. Specifically, four air outlets are formed in one side of the housing, i.e., a first air outlet 141 close to the top of a wiring base of a wiring terminal at one side of the housing, a second air outlet 142 close to the bottom of the wiring base, as well as a third air outlet 143 and a fourth air outlet 144 which are positioned on the sidewall and the bottom edge of the bottom of one side of the housing respectively. The first air outlet 141 and the second air outlet 142 are completely isolated from the third air outlet 143 and the fourth air outlet 144 by means of the first partitioning rib 121 to form the upper air flow passage 13c and the lower air flow passage. The first air outlet 141 and the second air outlet 142 are communicated with the gaps 2a between more than half of the arc extinguishing grid-plates 2. The second partitioning rib 122 partially isolates the third air outlet 143 from the fourth air outlet 144 to guide the high temperature airflows, and separates the lower airflow passage to form the first lower airflow passage 13a and the second lower airflow passage 13b. One end of the second partitioning rib 122 is connected to the gap 2a between the arc extinguishing grid-plates 2, the other end thereof

extends towards a space between the third air outlet 143 and the fourth air outlet 144, and a ventilation space is left to make the third air outlet 143 and the fourth air outlet 144 communicated. It is apparent that such structure enables the high temperature and high pressure airflows to be discharged from the four air outlets through the first lower air flow passage 13a, the second lower air flow passage 13b, and the upper air flow passage 13c to further improve smooth and rapid discharge and prevent the interference.

**[0024]** The utility model has a further beneficial effect: the miniature circuit breaker further comprises a front arc striking structure C disposed in the housing. As shown in Fig. 3, the front arc striking structure C comprises a plurality of arc-shaped arc striking grooves 16 which is disposed between the arc extinguishing grid-plates 2 on the grid-plate fixing structure A and the movable contact. The plurality of arc-shaped arc striking grooves 16 is in one-to-one correspondence with the gaps 2a between the plurality of arc extinguishing grid-plates 2. Specifically, the base 1 is provided with a plurality of upper arc striking ribs, and the housing cover 6 is correspondingly provided with a plurality of lower arc striking ribs. After the base 1 and the housing cover 6 are connected correspondingly, a space where the movable contact 3 is in contact with the movable contact 4 is formed between the upper arc striking ribs and the lower arc striking ribs. The movable contact 3 is disposed between the upper arc striking ribs and the lower arc striking ribs, and the movable contact 4 swings between the upper arc striking ribs and the lower arc striking ribs in a direction close to the arc extinguishing grid-plates 2. By means of the plurality of arc-shaped arc striking grooves 16, electric arcs generated by the movable contact and the static contact are rapidly guided to the gaps 2a between the plurality of arc extinguishing grid-plates 2 respectively, thereby improving the air flow passages of the electric arcs, improving the arc extinguishing capability of the circuit breaker and avoiding the assembly of elements, such as a magnetic conduction sheet.

**[0025]** The utility model has a yet further beneficial effect: the movable contact 3 having the arc striking structure and the arc striking plate 5 are disposed in such a manner: two ends of a coil of the electromagnetic trip device 8 are directly connected to the wiring plate and the static contact 3 respectively, and no support is disposed. The static contact 3 comprises a contact portion 31 provided with a movable contact point, an arc striking portion 32 and a yoke portion 33 which are sequentially connected. The yoke portion 33 is parallel to an axial direction of the coil of the electromagnetic trip device 8 and parallel to the arc extinguishing grid-plates 2. A V-shaped arc striking angle is formed between the contact portion 31 and the arc striking portion 32. The contact portion 31 and the arc striking portion 32 are located between the upper arc striking ribs of the base 1 and the lower arc striking ribs of the housing cover 6. The arc striking plate 5 comprises a straight section 51, a V-shaped

arc striking section 52 and a limiting section 53 connected to the bimetal sheet 9, which are sequentially connected. The straight section 51 is parallel to the arc extinguishing grid-plates 2. V-shaped fixing ribs for mounting the arc striking plate 5 are arranged in the housing. The V-shaped arc-extinguishing section 52 is correspondingly fitted with the V-shaped fixing ribs. The arc striking plate 5 is connected to the bimetal sheet 9 through the limiting section 53. A supporting protrusion 54 is provided on one side, corresponding to the limiting section 53, of the V-shaped fixing ribs, so that the arc striking plate 5 has elastic support, which ensures that the bimetal sheet 9 can be accurately restored to the original position after being overloaded and bent.

**[0026]** The utility model further has a beneficial effect in terms of the design of the base 1 and the housing cover 6, as well as the grid-plate 2 and the rear arc extinguishing structure B mounted thereon. There may be a plurality of manners, where a preferred manner is as shown in Figs. 4 and 6: the base 1 comprises a plurality of lower fixing ribs 11, a plurality of lower partitioning ribs 12, a plurality of lower air outlets 14, a plurality of lower arc striking ribs and a plurality of lower fixing grooves 15; the housing cover 6 comprises a plurality of upper fixing ribs 61, a plurality of upper partitioning ribs 62, a plurality of upper air outlets 64, a plurality of upper arc striking ribs and a plurality of upper fixing grooves 65. The static connection of the base 1 and the housing cover 6 should make the lower fixing ribs 11 aligned to the upper fixing ribs 61 one by one, the lower partitioning ribs 12 docked to the upper partitioning ribs 62 one by one, the lower air outlets 14 docked to the upper air outlets 64 one by one, and the lower arc striking ribs aligned to the upper arc striking ribs one by one. A distance between a bottom surface 15d (refer to Fig. 7) of each lower fixing groove 15 and a bottom surface 65d (refer to Fig. 8) of the corresponding upper fixing groove 65 is equal to the height H of the arc extinguishing grid-plate 2. It is apparent that the structure of the utility model makes it possible to select the number of the arc extinguishing grid-plates 2 when assembling the miniature circuit breaker and it is not necessary to change the structures on the base 1, the housing cover 6 and the arc extinguishing grid-plates 2 to meet the "multi-positioned" requirements. The lower partitioning ribs 12 are docked with the upper partitioning ribs 62 one by one, that is, each lower partitioning rib 12 is docked with the corresponding upper partitioning rib 62, i.e., each upper partitioning rib 12 is docked with the corresponding lower partitioning rib 12. The "docked" described herein refers to mutual butting by which, after the base 1 is statically connected to the housing cover 6, no convection of high temperature air flows occurs among the air flow passages partitioned by the docking of the lower partitioning ribs 12 and the upper partitioning ribs 62, thereby avoiding airflow interference between the two air flow passages. Moreover, the air outlets of the utility model may include combined air outlets and/or independent air outlets. As shown in Figs. 1 and 6, a lower air

outlet 14 and an upper air outlet 64 of each combined air outlet are a half opening respectively, and the two half openings are butted to form a complete air outlet. The independent air outlets (not shown in drawings) are respectively a complete lower air outlet formed in the base 1, and/or a complete upper air outlet formed in the housing cover 6. Regardless of whether it is the combined air outlet or the independent air outlet, each air outlet is communicated with the corresponding air flow passage 13, and the position of each air outlet may be designed according to the permission of the actual structure.

**[0027]** Of course, the rear arc extinguishing structure B and the front arc striking structure C of the miniature circuit breaker of the utility model are not only suitable for a miniature circuit breaker with multi-positioned arc extinguishing grid-plates, but also for a miniature circuit breaker adopting an arc extinguishing chamber structure. According to a second embodiment in Figs. 9-11, no grid-plate fixing structure A is disposed in the housing of the circuit breaker, but a plurality of arc extinguishing grid-plates is mounted inside the arc extinguishing chamber 10, and the air extinguishing chamber 10 is fixedly connected to the housing of the circuit breaker. Air discharge openings 101 are formed in the rear plate of the arc extinguishing chamber 10. A rear arc extinguishing structure B is disposed between the air discharge openings 101 of the arc extinguishing chamber 10 and the air outlets of the housing. The rear arc extinguishing structure B comprises a plurality of air flow passages disposed between the air discharge openings 101 of the arc extinguishing chamber 10 and the air outlets of the housing, such that high temperature air flow in the arc extinguishing chamber 10 passes through the air discharge openings 101 and the plurality of air flow channels, and is then discharged from the air outlets. Other structures in the circuit breaker of the embodiment, including the front arc striking structure C, the static contact, the moving contact, the arc striking plate, etc. are the same as those in the first embodiment. For example, the front arc extinguishing structure comprises a plurality of arc striking grooves disposed between an opening in the front side of the arc extinguishing chamber and the movable contact, which will not be repeated here again. The air flows flowing out from the grid-plates of the arc extinguishing chamber can be prevented from interfering with each other by disposing a plurality of air flow passages in front of the air outlet of the circuit breaker and behind the arc extinguishing chamber, hot air flows can be prevented from interfering with each other at the air discharge openings 101, and heat energy can be quickly dissipated, thereby quickly extinguishing electric arcs, enhancing an arc extinguishing effect of an arc extinguishing system and a breaking capability of the circuit breaker, and reducing the volume of the arc extinguishing chamber.

**[0028]** As shown in Fig. 11, a plurality of arc extinguishing grid-plates is disposed inside the arc extinguishing chamber 10. An arc extinguishing gap is formed between every two adjacent arc extinguishing grid-plates. The rear

plate of the arc extinguishing chamber 10 is provided with a plurality of air discharge openings 101. Preferably, each air discharge opening is in one-to-one correspondence with one arc extinguishing gap. The plurality of air discharge openings 101 in the rear plate of the arc extinguishing chamber 10 are disposed on two sides of the rear plate in two columns; the two columns of air discharge openings 101 are alternately disposed in staggered layers to prevent hot air flows from interfering with each other at the air discharge openings 101.

**[0029]** As shown in Figs. 9-10, the housing of the circuit breaker is provided with a plurality of air outlets each communicated with at least one air flow passage, and each air flow passage is communicated with the corresponding air discharge opening of the arc extinguishing chamber 10. In particular, the air flow passages of the rear arc extinguishing structure B include guide passages 131 and exhaust passages 132. Each guide passage 131 is communicated with at least one air discharge opening 101 and at least one exhaust passage 132. Each exhaust passage 132 is communicated with the corresponding air outlet. Preferably, the rear arc extinguishing structure B comprises a plurality of guide passages 131 and a plurality of exhaust passages 132. The number of the exhaust passages 132 is less than the number of the guide passages 131. The plurality of guide passages 131 are in one-to-one correspondence with the plurality of air discharge openings 101 behind the arc extinguishing chamber 10, to prevent hot air flows from interfering with each other at the air discharge openings 101. Each exhaust passage 132 is communicated with at least one guide passage 131 and at least one air outlet. The guide passages 131 are disposed in parallel with the arc extinguishing grid-plates to form a grid-type heat dissipation structure, and the exhaust passages 132 are disposed in an arc shape. The plurality of guide passages 131 is formed by partitioning with a plurality of horizontal partitioning ribs 134. The plurality of horizontal partitioning ribs 134 is disposed in parallel with the arc extinguishing grid-plates to form a grid-type heat dissipation structure. By means of the guide passages 131, hot gas expanded from the arc extinguishing chamber 10 flows towards the air outlets, and is then converged by the guide passages 131, and guided and discharged towards the air outlets, thereby effectively preventing hot air flows from interfering with each other at the air discharge openings 101, dissipating heat rapidly, extinguishing the electric arc rapidly and effectively reducing the volume of the arc extinguishing chamber 10. Of course, this is a preferred embodiment of the utility model, and the case where only the guide passages 131 or the exhaust passages 132 are provided may not be excluded. The case where only the guide passages 131 are provided is as in the first embodiment: i.e., the air flow passages of the rear arc extinguishing structure B are a plurality of guide passages 131 which are disposed between the air discharge openings 101 of the arc extinguishing chamber 10 and the air outlets of the housing and partitioned by the arc-

shaped partitioning ribs 133. When only the exhaust passages 132 are provided, that is, the exhaust passages 132 and the air outlets are not partitioned by the arc-shaped partitioning rib, that is, there is only one large guide passage 131.

**[0030]** In order to further improve the effects of extinguishing arc, cooling and discharging high temperature and high pressure air flows of the rear arc extinguishing structure B, a ratio of a length of each guide passage 131 of the rear arc extinguishing structure B to a length of the arc extinguishing chamber 10 is 0.2 to 0.5. Due to the size limitation from the housing of the circuit breaker, the length a of each flow passage 131 and the length b of the arc extinguishing chamber 10 have a complementary relationship. Therefore, the length of each guide passage 131 is lengthened by shortening the length b of the arc extinguishing chamber 10. Since the flow guiding channel 131 also has the effect of cooling the high-temperature airflow, in particular, due to the structure of the plurality of guide passages 131 formed by partitioning with the plurality of horizontal partitioning ribs 134, the horizontal partitioning ribs 134 form a grid-like heat dissipation structure. Moreover, the heat dissipation structure can obtain better cooling conditions such as heat dissipation area and heat capacity than the arc extinguishing grid-plates by optimizing the design, and therefore the cooling effect is particularly good. Even if the length b of the arc extinguishing chamber 10 is shortened, the cooling effect may be better. Therefore, the important factors in the optimized design of the utility model includes the ratio of the length a of each guide passage 131 to the length b of the arc extinguishing chamber 10.

**[0031]** In the embodiment as shown in Figs. 9-10, the rear arc extinguishing structure B comprises a plurality of guide passages 131 and a plurality of exhaust passages 132, where the number of the exhaust passages 132 is less than that of the guide passages 131. The plurality of guide passages 131 is in one-to-one correspondence with the plurality of air discharge openings 101 behind the arc extinguishing chamber 10. Four air outlets are formed in one side of the housing, i.e., a first air outlet 141 close to the top of a wiring base of a wiring terminal at one side of the housing, a second air outlet 142 close to the bottom of the wiring base, as well as a third air outlet 143 and a fourth air outlet 144 which are positioned on the sidewall and the bottom edge of the bottom of one side of the housing respectively. A space between the exhaust passages 132 and the four air outlets is partitioned by three arc-shaped partitioning ribs 133 to form four guide passages 131 which are in one-to-one correspondence with the four air outlets, wherein a ventilation space is preserved at the end part of the arc-shaped partitioning rib 133 that isolates the third air outlet 143 from the fourth air outlet 144, such that the third air outlet 143 is communicated with the fourth air outlet 144.

**[0032]** The above content is a further detailed description of the utility model made in conjunction with the spe-



cific preferred embodiments, and it is not intended that the specific embodiments of the utility model are limited to these descriptions. For an ordinary person skilled in the art to which the present utility model belongs, a number of simple deductions or substitutions may be made without departing from the spirit of the utility model should be considered to fall within the protection scope of the utility model.

## Claims

1. A miniature circuit breaker, comprising a housing having an air outlet, wherein a plurality of arc extinguishing grid-plates is mounted in an arc extinguishing chamber (10); the arc extinguishing chamber (10) is fixedly connected to the housing; an air discharge opening (101) is formed in a rear plate of the arc extinguishing chamber (10); a rear arc extinguishing structure is disposed between the air discharge opening (101) of the arc extinguishing chamber (10) and the air outlet of the housing; the rear arc extinguishing structure comprises a plurality of air flow passages disposed between the air discharge opening (101) of the arc extinguishing chamber (10) and the air outlet of the housing, such that high-temperature air flows in the arc extinguishing chamber (10) pass through the air discharge opening (101) and the plurality of air flow passages and are then discharged from the air outlet.
2. The miniature circuit breaker according to claim 1, wherein the air flow passages of the rear arc extinguishing structure include exhaust passage (132) and a plurality of guide passages (131); each guide passage (131) is communicated with at least one air discharge opening (101) and at least one exhaust passage (132); the exhaust passage (132) is communicated with the air outlet.
3. The miniature circuit breaker according to claim 2, wherein the rear arc extinguishing structure comprises a plurality of guide passages (131), and the plurality of guide passages (131) are in one-to-one correspondence with the plurality of air discharge openings (101) behind the arc extinguishing chamber (10).
4. The miniature circuit breaker according to claim 2, wherein the rear arc extinguishing structure comprises a plurality of guide passages (131) and a plurality of exhaust passages (132), where the number of the exhaust passages (132) is less than that of the guide passages (131); the plurality of guide passages (131) are in one-to-one correspondence with the plurality of air discharge openings (101) behind the arc extinguishing chamber (10); each exhaust passage (132) is communicated with at least one guide pas-

sage (131) and at least one air outlet.

5. The miniature circuit breaker according to claim 2, wherein the plurality of guide passages (131) is formed by partitioning with a plurality of horizontal partitioning ribs (134); the plurality of horizontal partitioning ribs (134) are disposed in parallel with the arc extinguishing grid-plates to form a grid-type heat dissipation structure.
6. The miniature circuit breaker according to claim 1, wherein the air flow passages of the rear arc extinguishing structure are a plurality of guide passages (131) which are disposed between the air discharging openings (101) of the arc extinguishing chamber (10) and the air outlets of the housing and partitioned by arc-shaped partitioning ribs (133).
7. The miniature circuit breaker according to any one of claims 2 to 5, wherein a ratio of a length of each guide passage (131) of the rear arc extinguishing structure to a length of the arc extinguishing chamber (10) is 0.2 to 0.5.
8. The miniature circuit breaker according to claim 1, wherein a plurality of arc extinguishing grid-plates is disposed in the arc extinguishing chamber (10); an arc extinguishing gap is formed between every two adjacent arc extinguishing grid-plates; a plurality of air discharge openings (101) is formed in the rear plate of the arc extinguishing chamber (10); each air discharge opening is in one-to-one correspondence with one arc extinguishing gap; the plurality of air discharge openings (101) in the rear plate of the arc extinguishing chamber (10) are disposed on two sides of the rear plate in two columns; the two columns of air discharge openings (101) are alternately disposed in staggered levels.
9. The miniature circuit breaker according to claim 4, wherein four air outlets are formed in one side of the housing, i.e., a first air outlet (141) close to the top of a wiring base of a wiring terminal at one side of the housing, a second air outlet (142) close to the bottom of the wiring base, as well as a third air outlet (143) and a fourth air outlet (144) which are positioned on the sidewall and the bottom edge of the bottom of one side of the housing respectively; a space between the exhaust passages (132) and the four air outlets is partitioned by three arc-shaped partitioning ribs (133) to form four guide passages (131) which are in one-to-one correspondence with the four air outlets, wherein a ventilation space is preserved at the end part of the arc-shaped partitioning rib (133) that isolates the third air outlet (143) from the fourth air outlet (144), such that the third air outlet (143) is communicated with the fourth air outlet (144).

10. The miniature circuit breaker according to claim 1, further comprising a front arc extinguishing structure disposed in the housing; the front arc extinguishing structure comprises a plurality of arc striking grooves which is disposed between an opening in the front side of the arc extinguishing chamber and a static contact.

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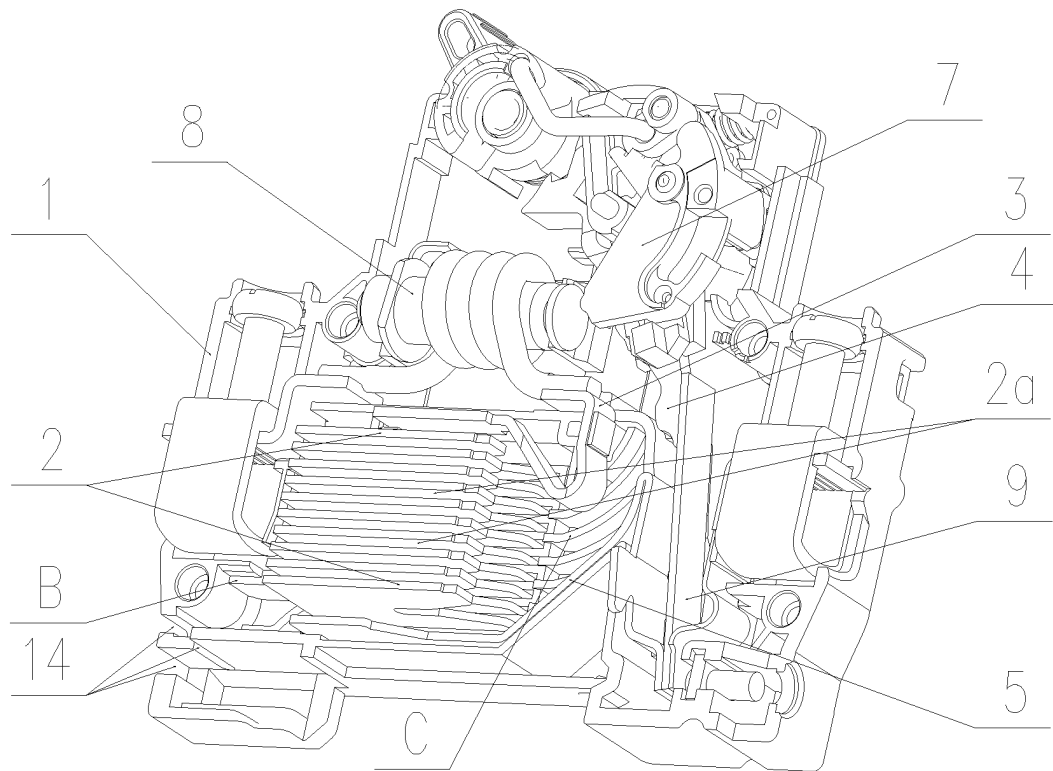


Fig.1

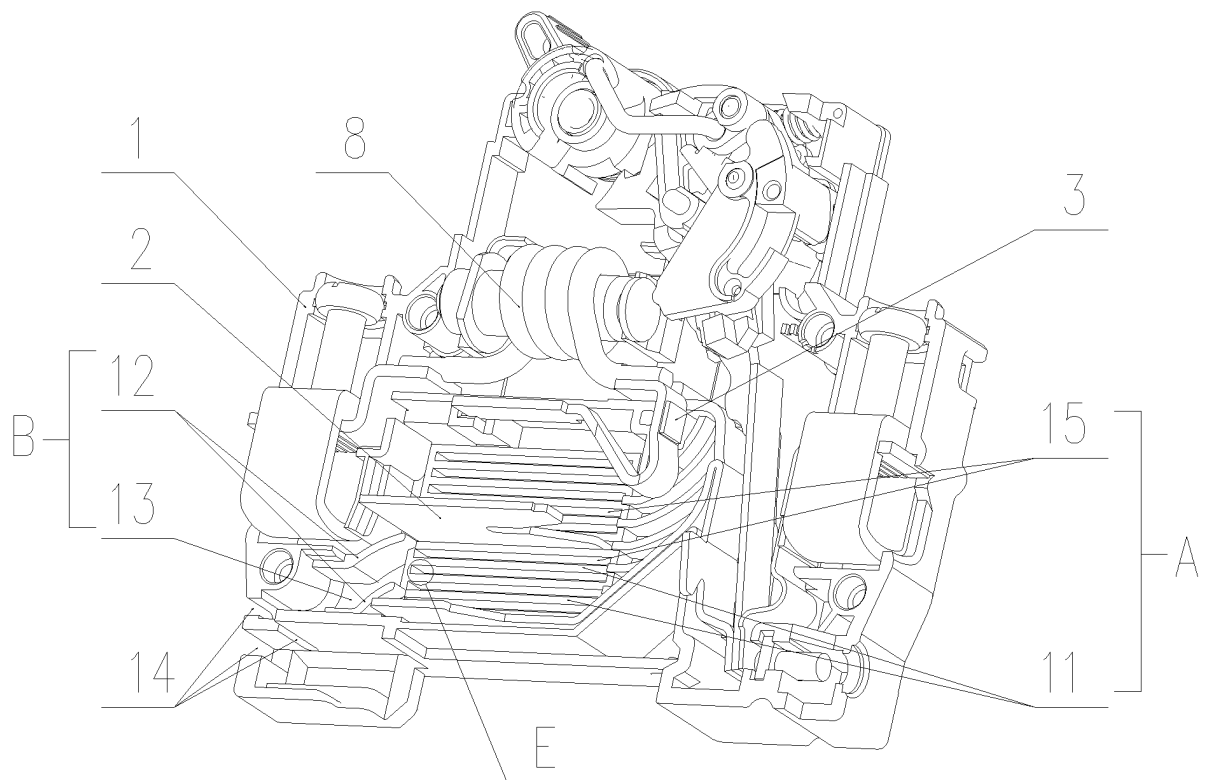


Fig.2

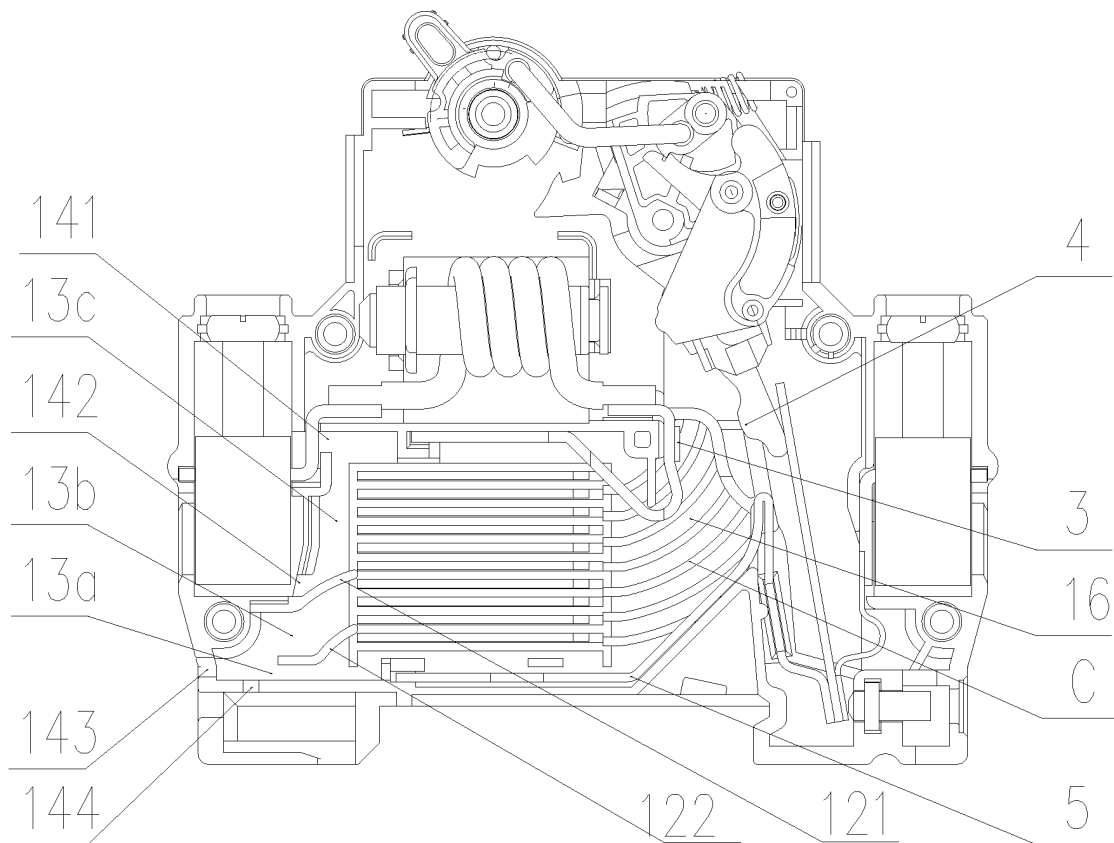


Fig.3

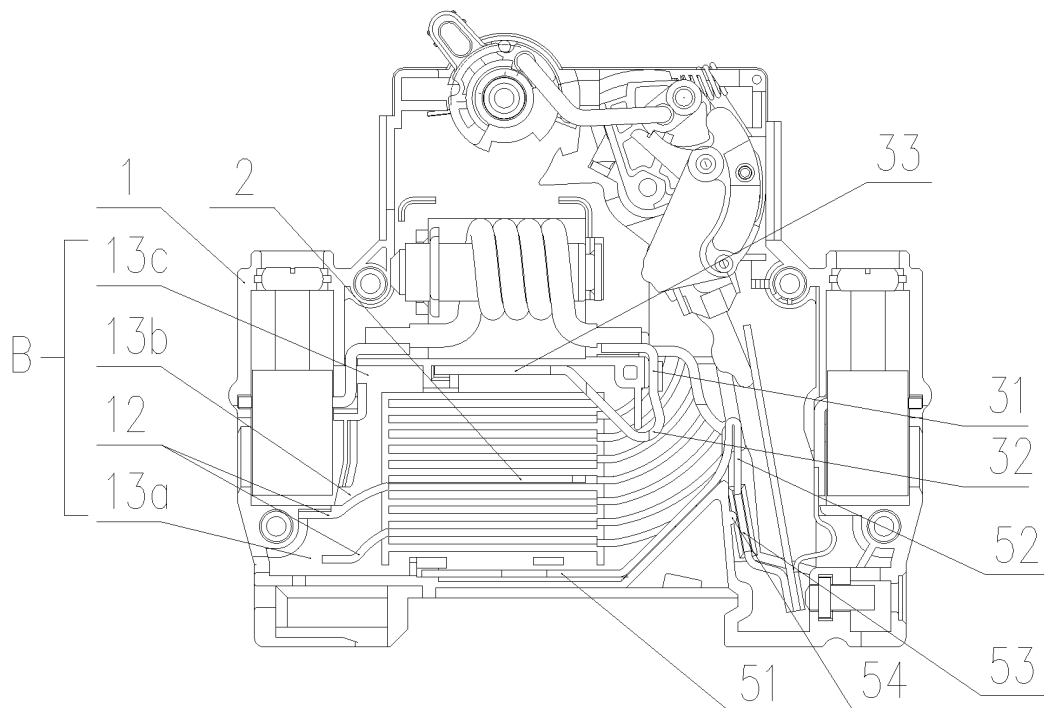


Fig.4

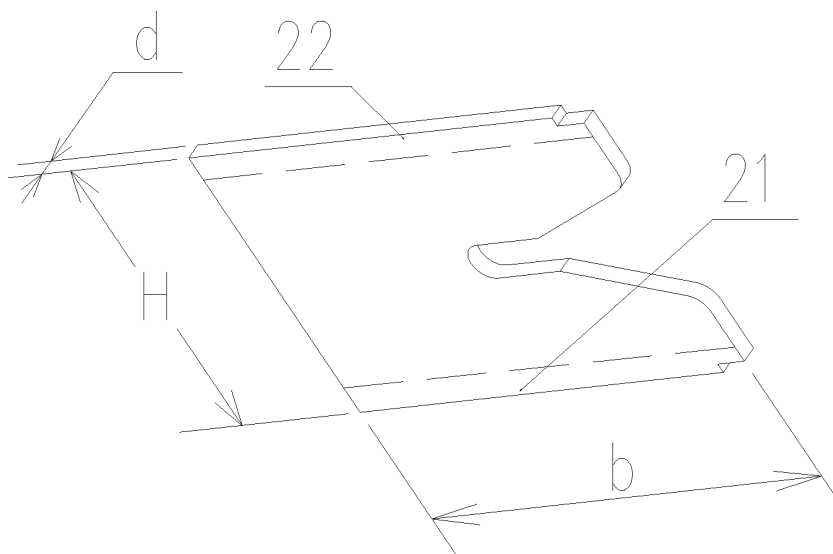


Fig.5

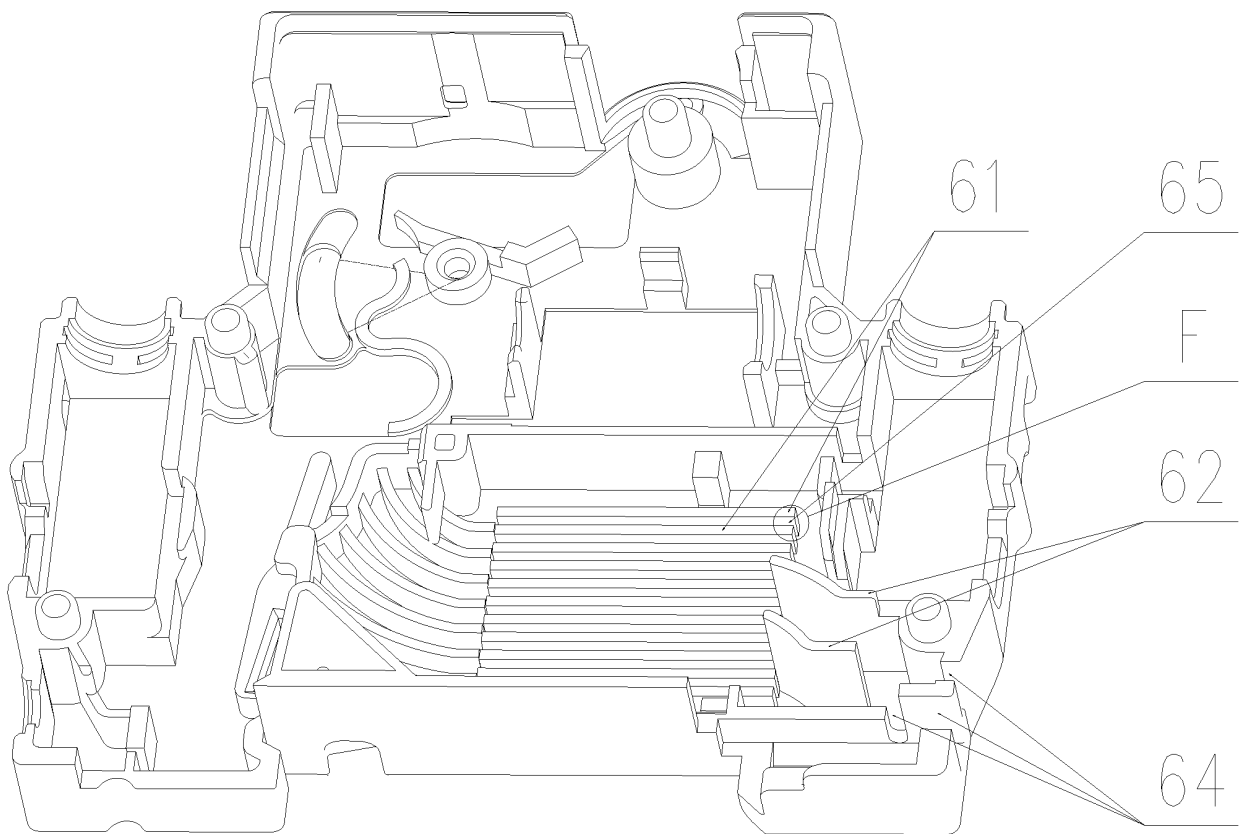


Fig.6

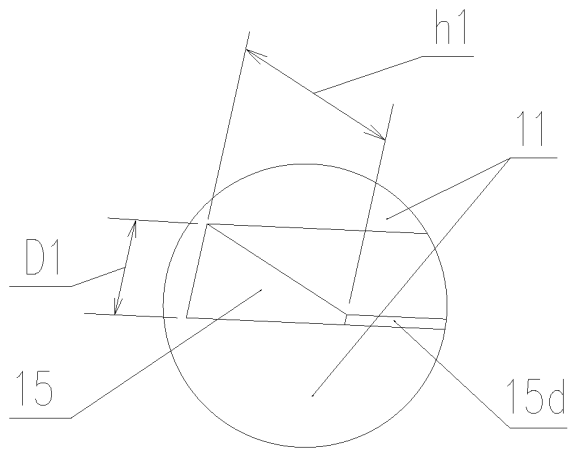


Fig.7

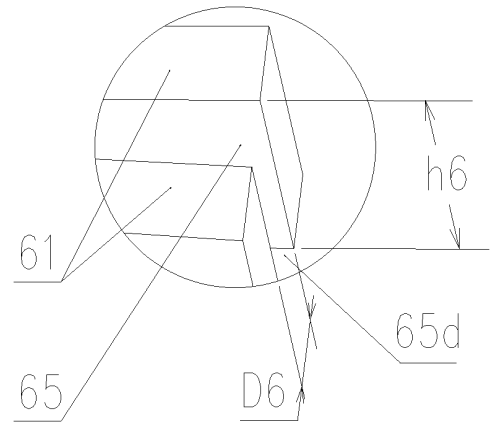


Fig.8

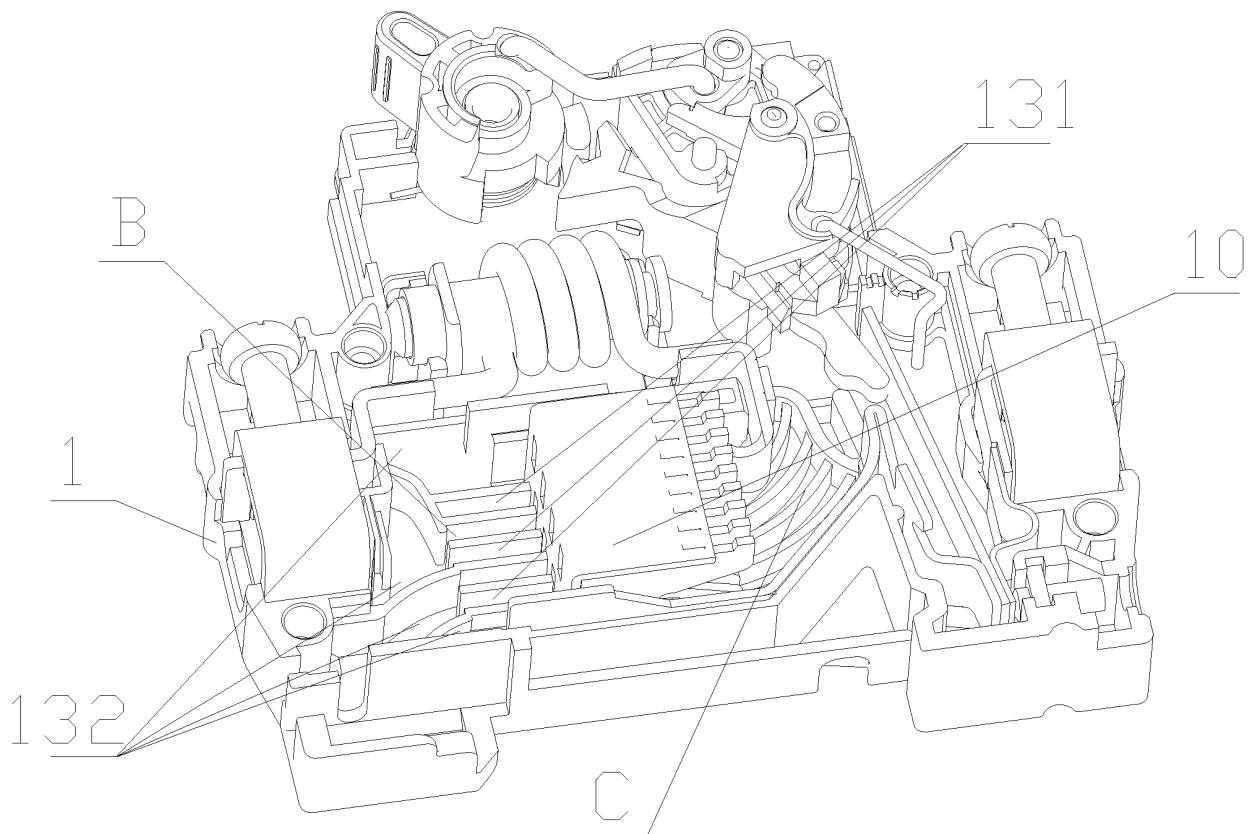


Fig.9

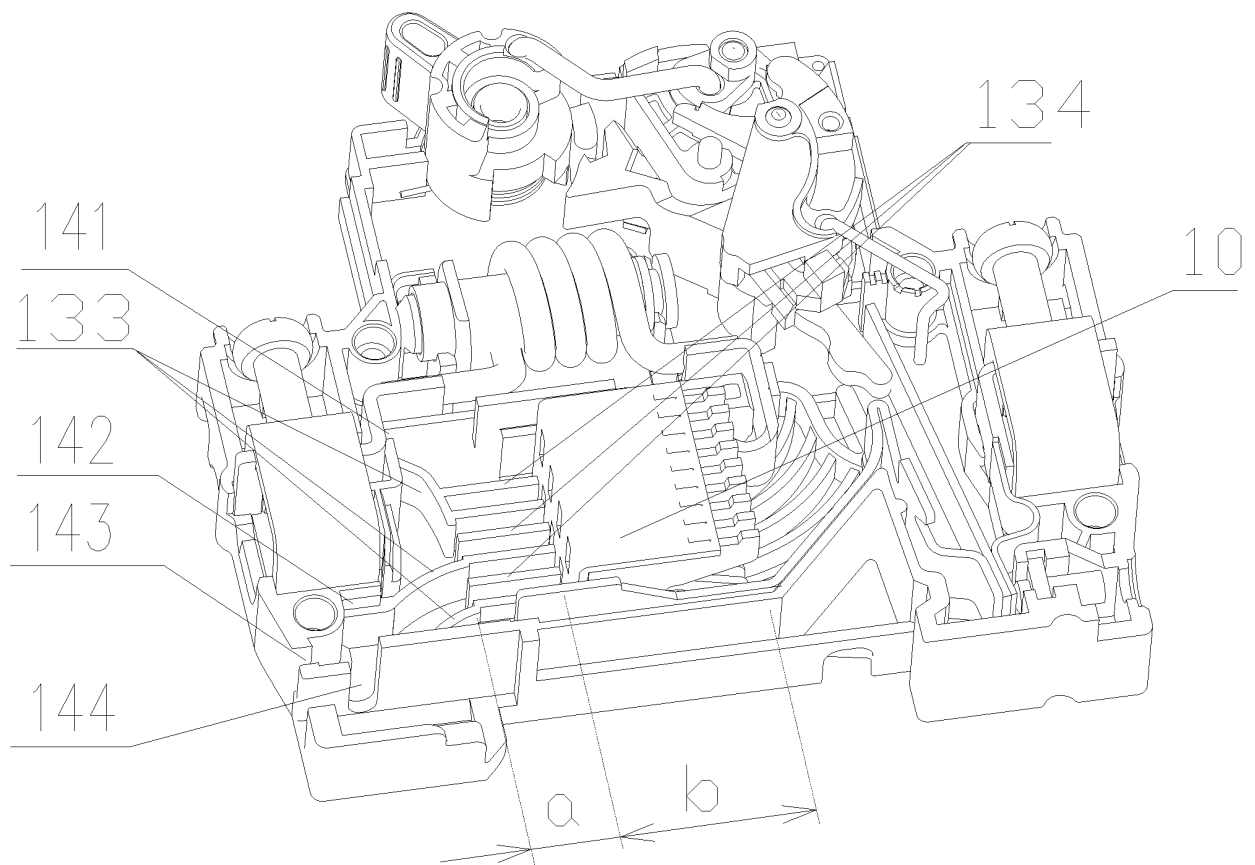


Fig.10

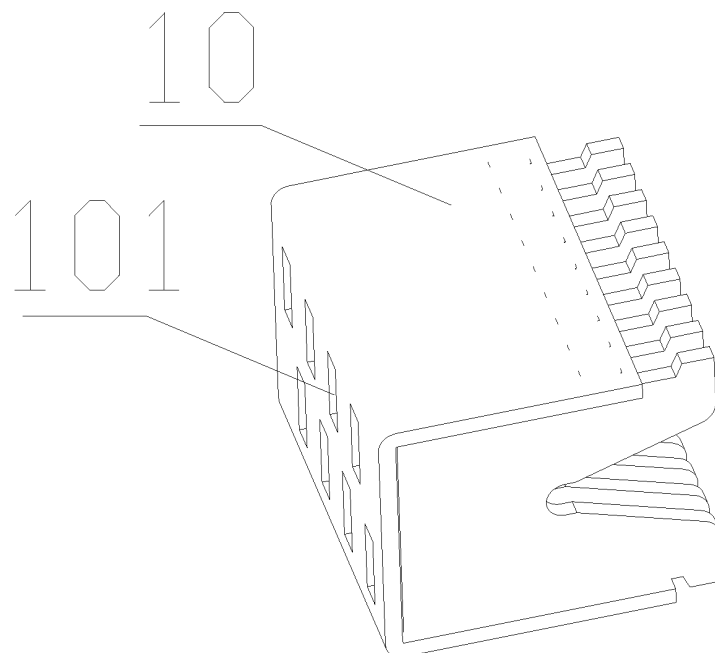


Fig.11

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/103065

## A. CLASSIFICATION OF SUBJECT MATTER

H01H 73/18 (2006.01) i; H01H 9/34 (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 73, H01H 9

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)

CNPAT, WPI, EPODOC, CNKI: arc extinguishing, ventilate, air hole, air vent, breaker, arc, extinguish+, suppress+, barrier, exhaust, channel, pass+, hole, vent

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 205621690 U (ZHEJIANG CHINT ELECTRICS CO., LTD.), 05 October 2016 (05.10.2016), claims 1-10, description, paragraphs 27-40, and figures 1-11	1-10
PX	CN 205621689 U (ZHEJIANG CHINT ELECTRICS CO., LTD.), 05 October 2016 (05.10.2016), description, paragraphs 28-40, and figures 1-11	1-10
PX	CN 205621691 U (ZHEJIANG CHINT ELECTRICS CO., LTD.), 05 October 2016 (05.10.2016), description, paragraphs 23-25 and 28, and figures 1, 2 and 5	1, 6, 8, 10
X	CN 103021756 A (DELIXI ELECTRIC LTD.), 03 April 2013 (03.04.2013), description, paragraphs 16, 18 and 19, and figures 6-9	1, 6, 8, 10
X	CN 204558302 U (ZHEJIANG FENGYUAN ELECTRICAL PARTS CO., LTD.), 12 August 2015 (12.08.2015), description, paragraphs 18 and 19, and figure 1	1, 6, 8, 10
X	CN 204011327 U (FATO MECHANICAL & ELECTRICAL EQUIPMENT GROUP COMPANY LTD.), 10 December 2014 (10.12.2014), description, paragraphs 23-26, and figures 2, 3 and 5	1, 6, 8, 10
X	CN 104201074 A (CNC ELECTRIC GROUP CO., LTD.), 10 December 2014 (10.12.2014), description, paragraphs 11-14, and figures 1 and 3	1, 6, 8, 10

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

\* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

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“&” document member of the same patent family

Date of the actual completion of the international search

16 January 2017 (16.01.2017)

Date of mailing of the international search report

04 February 2017 (04.02.2017)

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/103065

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 203839318 U (BOER (YIXING) POWER SYSTEM CO., LTD.), 17 September 2014 (17.09.2014), description, paragraph 20, and figure 5	1, 6, 8, 10
X	CN 201549460 U (HANGZHOU HONYAR-GEYER ELECTRICAL CO., LTD. et al.), 11 August 2010 (11.08.2010), description, paragraph 13, and figure 1	1, 6, 8, 10
X	CN 201820726 U (XI'AN TIANSHUI 213 ELECTRICAL APPARATUS CO., LTD.), 04 May 2011 (04.05.2011), description, paragraphs 22-27, and figures 1 and 2	1, 6, 8, 10
A	EP 2416334 A1 (EATON INDUSTRIES NETHERLANDS B.V.), 08 February 2012 (08.02.2012), the whole document	1-10

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.

**PCT/CN2016/103065**

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CN 205621690 U	05 October 2016	None	
CN 205621689 U	05 October 2016	None	
CN 205621691 U	05 October 2016	None	
CN 103021756 A	03 April 2013	CN 103021756 B	07 October 2015
CN 204558302 U	12 August 2015	None	
CN 204011327 U	10 December 2014	None	
CN 104201074 A	10 December 2014	None	
CN 203839318 U	17 September 2014	None	
CN 201549460 U	11 August 2010	None	
CN 201820726 U	04 May 2011	None	
EP 2416334 A1	08 February 2012	WO 2006065129 A1	22 June 2006
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Form PCT/ISA/210 (patent family annex) (July 2009)