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CIRCUIT BREAKER

Abstract

A circuit breaker including a housing, a line terminal, a load terminal, a trip device, a thermal trip mechanism, a magnetic trip mechanism, an arc extinguish chamber, a handle assembly, a one-piece line terminal lug, and a one-piece load terminal lug. The trip device includes a link assembly and a movable contact assembly. The movable contact assembly includes a movable contact; the thermal trip mechanism includes a bimetallic strip and a thermal trip hook connected to a first end of the bimetallic strip. The magnetic trip mechanism includes a moving iron core, a stationary iron core, a magnetic spring, and a firing pin. The one-piece line terminal lug includes a first bottom part and an inlet connection part and is configured to directly introduce an external power into the circuit breaker. The first bottom part is disposed at the bottom of the line terminal.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of International Patent Application No. PCT/CN2024/103740 with an international filing date of Jul. 5, 2024, designating the United States, now pending, further claims foreign priority benefits to Chinese Patent Application No. 202321849518.3 filed Jul. 14, 2023. The contents of all of the aforementioned applications, including any intervening amendments thereto, are incorporated herein by reference. Inquiries from the public to applicants or assignees concerning this document or the related applications should be directed to: Matthias Scholl P.C., Attn.: Dr. Matthias Scholl Esq., 245 First Street, 18th Floor, Cambridge, MA 02142.

BACKGROUND

[0002] The disclosure relates to a circuit breaker.

[0003] The circuit breakers are common circuit protection components that disconnect the circuit in the event of short circuit, overload, or other abnormal situations, thereby protecting the circuit. Existing circuit breakers usually use soldering to connect various components, and the reliability of the solder points affects the reliability of the circuit breaker. Poor contact often occurs, so this type of circuit breaker can only be used in low current scenarios. In addition, there is a lack of directional guidance for the electric arc generated during the tripping process, which causes some arcs to overflow into the circuit breaker without entering the arc extinguish chamber. This not only damages the internal structure of the circuit breaker but also poses a fire hazard. In particular, due to the limited internal space of the circuit breaker, the tripping mechanism of the existing circuit breaker is usually single-sided tripping, and there is a couple of forces during tripping, which may result in improper tripping or damage to the tripping mechanism.

SUMMARY

[0004] To solve the aforesaid problems, the disclosure provides a circuit breaker comprising a housing, a line terminal, a load terminal, a trip device, a thermal trip mechanism, a magnetic trip mechanism, an arc extinguish chamber, a handle assembly, a one-piece line terminal lug, and a one-piece load terminal lug.

[0005] The line terminal, the load terminal, the trip device, the thermal trip mechanism, the magnetic trip mechanism, the arc extinguish chamber, and the handle assembly are disposed in the housing.

[0006] The trip device comprises a link assembly and a movable contact assembly; the movable contact assembly comprises a movable contact; the thermal trip mechanism comprises a bimetallic strip and a thermal trip hook connected to a first end of the bimetallic strip; the magnetic trip mechanism comprises a moving iron core, a stationary iron core, a magnetic spring, and a firing pin; the one-piece line terminal lug comprises a first bottom part and an inlet connection part and is configured to directly introduce an external power into the circuit breaker; the first bottom part is disposed at a bottom of the line terminal and is directly connected to an external power line; the inlet connection part is soldered to a second end of the bimetallic strip, and a thickness of the inlet connection part is smaller than that of the first bottom part; the one-piece load terminal lug is configured to directly output the external power in the circuit breaker to an external load; the one-piece load terminal lug comprises at least a coil part, and the coil part is disposed outside the magnetic trip mechanism and is configured to trigger the magnetic trip mechanism to trip when a

strong current passes through the coil part.
[0007] In a class of this embodiment, the circuit breaker further comprises a one-piece arc chute configured to guide all electric arcs generated in the circuit breaker into the arc extinguish chamber to prevent circuit hazards caused by arc overflow; the one-piece arc chute comprises an arc access part, an arc connection part, an arc guiding part, two side blocking parts, and a bottom plate; the arc access part is soldered to the second end of the bimetallic strip; the arc access part extends parallel to the bimetallic strip in one direction at an equal height; the bottom plate is disposed at a bottom of the arc extinguish chamber, and the arc guiding part is disposed between the arc access part and the bottom plate; the arc guiding part is tilted towards the arc extinguish chamber, and a projection of the static contact on the arc guiding part is close to or in a middle position of the arc guiding part; and the two side blocking parts are respectively disposed on both sides of the arc guiding part.
[0008] In a class of this embodiment, the circuit breaker further comprises two arc shields disposed outside the two side blocking parts, respectively, and the two arc shields comprise gas-generating nylon material.
[0009] In a class of this embodiment, the circuit breaker further comprises an adjustment part configured to adjust the bimetallic strip and the inlet connection part, or to adjust positions of the bimetallic strip, the inlet connection part, and the arc access part in the circuit breaker; the adjustment part comprises a connection plate and a tightening screw; the connection plate comprises a snap-in groove, a strip groove connected to the snap-in groove, and a threaded part disposed in the strip groove; the bimetallic strip and the inlet connection part are embedded in the snap-in groove, or the bimetallic strip, the inlet connection part, and the arc access part are embedded in the snap-in groove; the tightening screw is fixed on the housing, passes through the strip groove and is connected to the threaded part; by adjusting the tightening screw, positions of components embedded in the snap-in groove in the circuit breaker are adjusted.
[0010] In a class of this embodiment, the link assembly comprises a magnetic trip unit, a thermal trip unit, and a connection rod; the magnetic trip unit and the thermal trip unit are connected by interference fit, and the magnetic trip unit comprises a cross bar, a first axial hole, and a first side release; the cross bar disengages the circuit breaker when being struck by the firing pin; the thermal trip unit comprises a matching part, a thermal trip part, a second axial hole, a second side release, and a manual trip part; the matching part and the cross bar are connected by interference fit; the thermal trip part is disposed on an outer side of a connection position of the magnetic trip unit and the thermal trip unit, and when subjected to a pulling force of the thermal trip hook, the thermal trip part causes the circuit breaker to trip; the first axial hole and the second axial hole are of one size and the first axial hole and the second axial hole are coaxial; the manual trip part is connected to the handle assembly; the handle assembly operates to drive the manual trip part to trip the circuit breaker; the connection rod passes through the first axial hole, the movable contact assembly, and the second axial hole in sequence; the first side release and the second side release are interference fit, and the first side release and the second side release are coaxial, facilitating a connection between the circuit breaker and an external unit for tripping.
[0011] In a class of this embodiment, two sides of the housing are provided with trip slots; the external unit passes through the trip slots of the housing and is connected to the first side release and/or the second side release to trip the circuit breaker by the external unit.
[0012] In a class of this embodiment, the circuit breaker further comprises a current transformer; the one-piece line terminal lug further comprises a bending part passing through the current transformer; the current transformer outputs a current passing through the bending part to a load at a reciprocal of a number of coils of the current transformer.
[0013] In a class of this embodiment, the one-piece load terminal lug comprises a conductor part, a second bottom part, and a guiding part; the conductor part comprises a static contact; the second bottom part is disposed at a bottom of the load terminal, and the guiding part is disposed on one end of the conductor part adjacent to the arc extinguish chamber, for guiding an electric arc into the

arc extinguish chamber.
[0014] The following advantages are associated with the circuit breaker of the disclosure.
[0015] 1. The line terminal lug in the circuit breaker is an integrated design, and the external power line can be directly introduced into the circuit breaker through the terminal lug. The integrated design is more stable and reliable than solder joints.
[0016] 2. The load terminal in the circuit breaker adopts an integrated design, and the load terminal integrates a coil part, making the current passing through the coil part more stable and the trip more accurate.
[0017] 3. The circuit breaker comprises a one-piece arc chute and two arc shields made of gas-generating nylon material, so that the electric arc generated during tripping can be introduced into the arc extinguish chamber, avoiding safety hazards caused by arc overflow.
[0018] 4. The link assembly of the circuit breaker comprises a magnetic trip unit and a thermal trip unit which are interconnected by interference fit. The link assembly is fixed to the housing through the connection rod, making the link assembly more stable during rotation and avoiding unstable release caused by the force couples. In addition, the side releases are disposed on the link assembly, and the external unit is connected to the circuit breaker through the side releases, allowing the circuit breaker to release under the command of the external unit, expanding the application scenarios of the circuit breaker.
[0019] 5. The current transformer is disposed on the bending part of the one-piece line terminal lug of the circuit breaker. The current transformer converts and outputs the circuit data passing through the line terminal, and the circuit data in the circuit breaker is monitored through a backend platform. Thus, the circuit breaker is intelligent.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0020] FIG. **1** is a schematic diagram of a circuit breaker according to one embodiment of the disclosure;
[0021] FIG. **2** is a schematic diagram of an internal structure of a circuit breaker according to one embodiment of the disclosure;
[0022] FIG. **3**A-**3**B are schematic diagrams of a one-piece line terminal lug of a circuit breaker according to two embodiments of the disclosure, respectively;
[0023] FIG. **4** is a schematic diagram of a one-piece load terminal lug a circuit breaker according to one embodiment of the disclosure;
[0024] FIG. **5** is a schematic diagram of a one-piece arc chute of a circuit breaker according to one embodiment of the disclosure; and
[0025] FIG. **6** is a schematic diagram of a link assembly of a circuit breaker according to one embodiment of the disclosure.
[0026] In the drawings, the following reference numbers are used:
[0027] **10**. Housing; **101**. Trip slot; **11**. Line terminal, **12**. Load terminal, **13**. Handle assembly; **14**. Trip device; **141**. Link assembly; **1411**. Magnetic trip unit; **14111**. Cross bar; **14112**. First axial hole; **14113**. First side release; **1412**. Connection rod; **1413**. Thermal trip unit; **14131**. Matching part; **14132**. Thermal trip part; **14133**. Second axial hole; **14134**. Second side release; **14135**. Manual trip part; **142**. Movable contact assembly; **1421**. Movable contact; **15**. Thermal trip mechanism; **151**. Bimetallic strip; **152**. Thermal trip hook; **16**. Magnetic trip mechanism; **161**. Firing pin; **17**. Arc extinguish chamber; **18**. One-piece line terminal lug; **181**. First bottom part; **182**. Inlet connection part; **183**. Bending part; **19**. One-piece load terminal lug; **191**. Conductor part; **1911**. Static contact; **192**. Coil part; **193**. Second bottom part; **194**. Guiding part; **20**. One-piece arc chute; **201**. Arc access part; **202**. Arc connection part; **203**. Arc guiding part; **204**. Side

blocking part; **205**. Bottom plate; **21**. Arc shield; **22**. Adjustment part; **221**. Connection plate; **2211**. Snap-in groove; **2212**. Strip groove; **2213**. Threaded part; **222**. Tightening screw; **23**. Current transformer.

DETAILED DESCRIPTION

[0028] To further illustrate the disclosure, embodiments detailing a circuit breaker are described below. It should be noted that the following embodiments are intended to describe and not to limit the disclosure.

[0029] As shown in FIGS. **1** and **2**, a circuit breaker comprises a housing **10**, and inside the housing, there are a line terminal **11**, a load terminal **12**, a handle assembly **13**, a trip device **14**, a thermal trip mechanism **15**, a magnetic trip mechanism **16**, and an arc extinguish chamber **17**. The trip device **14** comprises a link assembly **141** and a movable contact assembly **142**; the movable contact assembly **142** comprises a movable contact **1421**; the thermal trip mechanism **15** comprises a bimetallic strip **151** and a thermal trip hook **152** connected to a first end of the bimetallic strip; the magnetic trip mechanism **16** comprises a moving iron core, a stationary iron core, a magnetic spring (not shown in the drawings), and a firing pin **161**.

[0030] As shown in FIGS. **3**A-**3**B, the circuit breaker further comprises a one-piece line terminal lug **18**. The one-piece line terminal lug **18** comprises a first bottom part and an inlet connection part and is configured to directly introduce an external power into the circuit breaker; the first bottom part is disposed at a bottom of the line terminal and is directly connected to an external power line; the inlet connection part is soldered to a second end of the bimetallic strip, and a thickness of the inlet connection part is smaller than that of the first bottom part.

[0031] As shown in FIG. **3**A, the one-piece line terminal lug **18** comprises a first bottom part **181-1** and an inlet connection part **182-1**. The first bottom part **181-1** is directly connected to the external power line to conduct the current to the bimetallic strip **151** through the inlet connection part **182-1**. In this embodiment, the one-piece line terminal lug **18** is designed without solder joints, with a simple structure, and is suitable for circuit breakers.

[0032] In another embodiment, as shown in FIG. **3**B, the circuit breaker is an intelligent circuit breaker comprising a current transformer **23**. The current transformer **23** can output the circuit data passing through it at a reciprocal of the number of coils of the current transformer **23**, so that the circuit data of the circuit breaker can be monitored externally through the data of the current transformer **23**. In this embodiment, the one-piece line terminal lug **18** comprises a first bottom part **181-2**, an inlet connection part **182-2**, and a bending part **183** passing through the current transformer **23**.

[0033] As shown in FIG. **4**, the circuit breaker further comprises a one-piece load terminal lug **19** configured to directly output the external power in the circuit breaker to an external load; the one-piece load terminal lug comprises a conductor part **191**, a coil part **192**, a second bottom part **193**, and a guiding part **194**; the conductor part **191** comprises a static contact **1911**; the coil part **192** is disposed outside the magnetic trip mechanism **16** and is configured to trigger the magnetic trip mechanism to trip when a strong current passes through the coil part. The second bottom part **193** is disposed at the bottom of the load terminal **12**, and the guiding part **194** is disposed on one end of the conductor part **191** adjacent to the arc extinguish chamber, for guiding an electric arc into the arc extinguish chamber.

[0034] It should be noted that when the movable contact **1421** and the static contact **1911** are closed, the current enters the coil part **192** through the conductor part **191**. When the movable contact **1421** and the static contact **1911** separate, the circuit is disconnected, and the electric arc generated when the movable contact **1421** and the static contact **1911** separate is guided into the arc extinguish chamber **17** through the guiding part **194**.

[0035] Understandably, the magnetic trip mechanism of the circuit breaker known to personnel in this field generates a magnetic field force when the current passing through the external coil is too high; the magnetic field force pushes the moving iron core to compress the magnetic spring and

causes the firing pin to strike the trip mechanism to achieve disengagement. Generally, the external coil is an independent coil that is connected to the circuit by soldering. In this embodiment, the coil part **192** is integrated on the one-piece load terminal lug **19**, without soldering points, making the current entering the coil part **192** more stable. The coil part **192** replaces the external coil in traditional circuit breakers and is located outside the magnetic trip mechanism **16**.

[0036] As shown in FIG. **5**, the circuit breaker further comprises a one-piece arc chute **20** configured to guide all electric arcs generated in the circuit breaker into the arc extinguish chamber to prevent circuit hazards caused by arc overflow; the one-piece arc chute **20** comprises an arc access part **201**, an arc connection part **202**, an arc guiding part **203**, two side blocking parts **204**, and a bottom plate **205**; the arc access part **201** is soldered to the second end of the bimetallic strip; the arc access part **201** extends parallel to the bimetallic strip in one direction at an equal height; the bottom plate **205** is disposed at a bottom of the arc extinguish chamber **17**, and the arc guiding part **203** is disposed between the arc access part and the bottom plate; the arc guiding part **203** is tilted towards the arc extinguish chamber, and a projection of the static contact **1911** on the arc guiding part is close to or in a middle position of the arc guiding part **203**; and the two side blocking parts **204** are respectively disposed on both sides of the arc guiding part.

[0037] Furthermore, the circuit breaker further comprises two arc shields **21** respectively disposed outside the two side blocking parts **204** to cooperate with the one-piece arc chute **20**, and the two arc shields comprise gas-generating nylon material.

[0038] Furthermore, the circuit breaker further comprises an adjustment part **22** configured to adjust the bimetallic strip **151** and the inlet connection part **182**, or to adjust positions of the bimetallic strip, the inlet connection part **182**, and the arc access part **201** in the circuit breaker; the adjustment part **22** comprises a connection plate **221** and a tightening screw **222**; the connection plate **221** comprises a snap-in groove **2211**, a strip groove **2212** connected to the snap-in groove, and a threaded part **2213** disposed in the strip groove **2212**; the bimetallic strip and the inlet connection part **182** are embedded in the snap-in groove **2211**, or the bimetallic strip, the inlet connection part **182**, and the arc access part **201** are embedded in the snap-in groove **2211**; the tightening screw **222** is fixed on the housing **10**, passes through the strip groove and is connected to the threaded part **2213**; by adjusting the tightening screw, the positions of the components embedded in the snap-in groove in the circuit breaker are adjusted.

[0039] As shown in FIG. **6**, the link assembly **141** comprises a magnetic trip unit **1411**, a thermal trip unit **1413**, and a connection rod **1412**; the magnetic trip unit and the thermal trip unit are connected by interference fit, and the magnetic trip unit comprises a cross bar **14111**, a first axial hole **14112**, and a first side release **14113**; the cross bar **14111** disengages the circuit breaker when being struck by the firing pin; the thermal trip unit **1413** comprises a matching part **14131**, a thermal trip part **14132**, a second axial hole **14133**, a second side release **14134**, and a manual trip part **14135**; the matching part **14131** and the cross bar are connected by interference fit; the thermal trip part **14132** is disposed on an outer side of a connection position of the magnetic trip unit **1411** and the thermal trip unit **1413**, and when subjected to a pulling force of the thermal trip hook, the thermal trip part causes the circuit breaker to trip; the first axial hole and the second axial hole are of the same size and the first axial hole and the second axial hole are coaxial; the manual trip part **14135** is connected to the handle assembly **13**; the handle assembly **13** operates to drive the manual trip part **14135** to trip the circuit breaker; the connection rod **1412** passes through the first axial hole, the movable contact assembly, and the second axial hole in sequence; the first side release and the second side release are interference fit, and the first side release and the second side release are coaxial, facilitating a connection between the circuit breaker and an external unit for tripping.

[0040] Furthermore, two sides of the housing **10** are provided with trip slots **101**; the external unit passes through the trip slots **101** of the housing and is connected to the first side release and/or the second side release to trip the circuit breaker by the external unit.

[0041] It will be obvious to those skilled in the art that changes and modifications may be made, and therefore, the aim in the appended claims is to cover all such changes and modifications.

Claims

1. A circuit breaker, comprising: a housing; a line terminal, a load terminal, a trip device, a thermal trip mechanism, a magnetic trip mechanism, an arc extinguish chamber, and a handle assembly, all of which are disposed in the housing; a one-piece line terminal lug; and a one-piece load terminal lug; wherein: the trip device comprises a link assembly and a movable contact assembly; the movable contact assembly comprises a movable contact; the thermal trip mechanism comprises a bimetallic strip and a thermal trip hook connected to a first end of the bimetallic strip; the magnetic trip mechanism comprises a moving iron core, a stationary iron core, a magnetic spring, and a firing pin; the one-piece line terminal lug comprises a first bottom part and an inlet connection part and is configured to directly introduce an external power into the circuit breaker; the first bottom part is disposed at a bottom of the line terminal and is directly connected to an external power line; the inlet connection part is soldered to a second end of the bimetallic strip, and a thickness of the inlet connection part is smaller than that of the first bottom part; and the one-piece load terminal lug is configured to directly output the external power in the circuit breaker to an external load; the one-piece load terminal lug comprises at least a coil part, and the coil part is disposed outside the magnetic trip mechanism and is configured to trigger the magnetic trip mechanism to trip when a strong current passes through the coil part.

2. The circuit breaker of claim 1, further comprising a one-piece arc chute configured to guide all electric arcs generated in the circuit breaker into the arc extinguish chamber to prevent circuit hazards caused by arc overflow; wherein the one-piece arc chute comprises an arc access part, an arc connection part, an arc guiding part, two side blocking parts, and a bottom plate; the arc access part is soldered to the second end of the bimetallic strip; the arc access part extends parallel to the bimetallic strip in one direction at an equal height; the bottom plate is disposed at a bottom of the arc extinguish chamber, and the arc guiding part is disposed between the arc access part and the bottom plate; the arc guiding part is tilted towards the arc extinguish chamber, and a projection of a static contact of the one-piece load terminal lug on the arc guiding part is close to or in a middle position of the arc guiding part; and the two side blocking parts are respectively disposed on both sides of the arc guiding part.

3. The circuit breaker of claim 2, further comprising two arc shields disposed outside the two side blocking parts, respectively, wherein the two arc shields comprise gas-generating nylon material.

4. The circuit breaker of claim 1, further comprising an adjustment part configured to adjust the bimetallic strip and the inlet connection part, or to adjust positions of the bimetallic strip, the inlet connection part, and the arc access part in the circuit breaker, wherein the adjustment part comprises a connection plate and a tightening screw; the connection plate comprises a snap-in groove, a strip groove connected to the snap-in groove, and a threaded part disposed in the strip groove; the bimetallic strip and the inlet connection part are embedded in the snap-in groove, or the bimetallic strip, the inlet connection part, and the arc access part are embedded in the snap-in groove; the tightening screw is fixed on the housing, passes through the strip groove and is connected to the threaded part.

5. The circuit breaker of claim 2, further comprising an adjustment part configured to adjust the bimetallic strip and the inlet connection part, or to adjust positions of the bimetallic strip, the inlet connection part, and the arc access part in the circuit breaker, wherein the adjustment part comprises a connection plate and a tightening screw; the connection plate comprises a snap-in groove, a strip groove connected to the snap-in groove, and a threaded part disposed in the strip groove; the bimetallic strip and the inlet connection part are embedded in the snap-in groove, or the bimetallic strip, the inlet connection part, and the arc access part are embedded in the snap-in

groove; the tightening screw is fixed on the housing, passes through the strip groove and is connected to the threaded part.

6. The circuit breaker of claim 1, wherein the link assembly comprises a magnetic trip unit, a thermal trip unit, and a connection rod; the magnetic trip unit and the thermal trip unit are connected by interference fit, and the magnetic trip unit comprises a cross bar, a first axial hole, and a first side release; the cross bar disengages the circuit breaker when being struck by the firing pin; the thermal trip unit comprises a matching part, a thermal trip part, a second axial hole, a second side release, and a manual trip part; the matching part and the cross bar are connected by interference fit; the thermal trip part is disposed on an outer side of a connection position of the magnetic trip unit and the thermal trip unit, and when subjected to a pulling force of the thermal trip hook, the thermal trip part causes the circuit breaker to trip; the first axial hole and the second axial hole are of one size and the first axial hole and the second axial hole are coaxial; the manual trip part is connected to the handle assembly; the handle assembly operates to drive the manual trip part to trip the circuit breaker; the connection rod passes through the first axial hole, the movable contact assembly, and the second axial hole in sequence; the first side release and the second side release are interference fit, and the first side release and the second side release are coaxial, facilitating a connection between the circuit breaker and an external unit for tripping.

7. The circuit breaker of claim 6, wherein two sides of the housing are provided with trip slots; the external unit passes through the trip slots of the housing and is connected to the first side release and/or the second side release to trip the circuit breaker by the external unit.

8. The circuit breaker of claim 1, further comprising a current transformer, wherein the one-piece line terminal lug further comprises a bending part passing through the current transformer; the current transformer outputs a current passing through the bending part to a load at a reciprocal of a number of coils of the current transformer.

9. The circuit breaker of claim 1, wherein the one-piece load terminal lug comprises a conductor part, a second bottom part, and a guiding part; the conductor part comprises a static contact; the second bottom part is disposed at a bottom of the load terminal, and the guiding part is disposed on one end of the conductor part adjacent to the arc extinguish chamber, for guiding an electric arc into the arc extinguish chamber.