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(54) A NEW ACCESSORY FOR CIRCUIT BREAKER STATUS PRE-ALARM AND MONITORING

(57) The embodiments of the present invention disclose a circuit breaker accessory and a circuit breaker assembly. The circuit breaker accessory comprises a trip arm detection module, connected to a trip arm of a circuit breaker and configured to detect a movement track of the trip arm; and a control module, configured to match the movement track to a preset tripping type track, and determine a tripping type of the circuit breaker on the basis of a matching result. The embodiments of the present invention can detect the circuit breaker tripping type, and can also alert a user in advance regarding circuit breaker load adjustment and contact reliability of a circuit breaker contact.

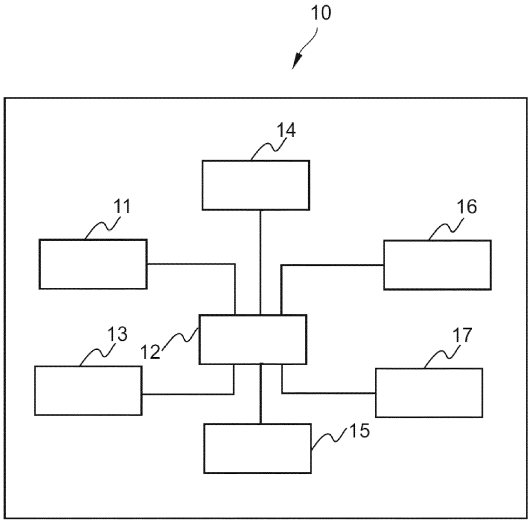

Figure 1

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Description

Technical field

[0001] The present invention relates to the field of electronic components, in particular to a circuit breaker accessory and a circuit breaker assembly.

Background art

[0002] A circuit breaker is a switch apparatus that is capable of turning on, carrying and turning off a current under normal circuit conditions, and capable of turning on, carrying and turning off a current under abnormal circuit conditions within a specified time. Circuit breakers are generally classed as high-voltage circuit breakers and low-voltage circuit breakers, according to their range of use. Circuit breakers can be used to distribute electrical energy, activate asynchronous motors infrequently, and protect power supply lines and motors, etc. When a fault such as a serious overload or short circuit and undervoltage occurs, a circuit breaker can automatically break the circuit; the function thereof is equivalent to a combination of a fuse-type switch and an over/underheating relay, etc.

[0003] A circuit breaker accessory cooperating with the circuit breaker can detect the state of the circuit breaker. However, an existing circuit breaker accessory can only provide simple information such as circuit breaker off, circuit breaker on and circuit breaker tripped; it is unable to determine the type of circuit breaker tripping.

[0004] Moreover, when the circuit breaker suffers a fault, the existing circuit breaker accessory cannot realize a pre-alarm.

Summary of the invention

[0005] The embodiments of the present invention propose a circuit breaker accessory and a circuit breaker assembly.

[0006] The technical solution of the embodiments of the present invention is as follows:

A circuit breaker accessory, comprising:

a trip arm detection module, connected to a trip arm of a circuit breaker and configured to detect a movement track of the trip arm;

a control module, configured to match the movement track to a preset tripping type track, and determine a tripping type of the circuit breaker on the basis of a matching result.

[0007] Thus, in embodiments of the present invention, by detecting the movement track of the trip arm of the circuit breaker, it is possible to determine the circuit breaker tripping type, thereby making it easy for a user to determine the cause of the fault quickly.

[0008] In one embodiment, also included is:

a handle detection module, connected to a handle of the circuit breaker and configured to detect a position of the handle;

wherein the control module is further configured to:

when the trip arm detection module detects the movement track and the handle is determined as being in an ON state on the basis of the position, determine a state of the circuit breaker as being: a freely tripped state when the handle is blocked;

when the trip arm detection module detects the movement track and the handle is determined as being in an OFF state on the basis of the position, determine a state of the circuit breaker as being: a normally tripped state;

when the trip arm detection module has not detected the movement track and the handle is determined as being in the OFF state on the basis of the position, determine a state of the circuit breaker as being: a manually opened state.

[0009] Clearly, in embodiments of the present invention, it is also possible to determine a state of the circuit breaker jointly on the basis of whether the trip arm detection module has detected the movement track of the trip arm, and the handle position detected by the handle detection module.

[0010] In one embodiment, also included is:

a first temperature detection module, arranged in a peripheral environment of a thermal system of the circuit breaker and configured to detect a first temperature value;

wherein the control module is further configured to generate a first alarm prompt for prompting adjustment of a load of the circuit breaker when the first temperature value is greater than a first predetermined threshold.

[0011] Thus, the circuit breaker accessory in an embodiment of the present invention can detect a temperature rise close to the circuit breaker thermal system, in order to alert the user in advance to adjust the circuit breaker load.

[0012] In one embodiment, also included is:

a second temperature detection module, arranged in a peripheral environment of a contact of the circuit breaker and configured to detect a second temperature value;

wherein the control module is further configured to generate a second alarm prompt for prompting contact reliability when the second temperature value is greater than a second predetermined threshold.

[0013] Thus, the circuit breaker accessory in an embodiment of the present invention can detect a temper-

ature rise at a point close to the circuit breaker contact, in order to alert the user in advance with regard to the contact reliability of the circuit breaker contact.

[0014] In one embodiment, the trip arm detection module comprises:

a trip arm connection component, configured to be connected to the trip arm of the circuit breaker;
a first magnet, arranged in the trip arm connection component;
a first Hall sensor, arranged at a periphery of a movement track of the trip arm connection component.

[0015] Clearly, the embodiments of the present invention also propose a specific structure of the trip arm detection module, to facilitate implementation.

[0016] In one embodiment, the handle detection module comprises:

a handle connection component, configured to be connected to the handle of the circuit breaker;
a second magnet, arranged in the handle connection component;
a second Hall sensor, arranged at a first position at a periphery of a movement track of the handle connection component, wherein the first position corresponds to the handle being in the ON state;
a third Hall sensor, arranged at a second position at a periphery of the movement track of the handle connection component, wherein the second position corresponds to the handle being in the OFF state.

[0017] Clearly, the embodiments of the present invention also propose a specific structure of the handle detection module, to facilitate implementation.

[0018] A circuit breaker assembly, comprising:

a circuit breaker, comprising a trip arm and a handle;
a circuit breaker accessory, comprising: a trip arm detection module, connected to the trip arm and configured to detect a movement track of the trip arm; and a control module, configured to match the movement track to a preset tripping type track, and determine a tripping type of the circuit breaker on the basis of a matching result.

[0019] Thus, by detecting the movement track of the trip arm of the circuit breaker, the circuit breaker assembly in embodiments of the present invention can determine the circuit breaker tripping type, thereby making it easy for a user to determine the cause of the fault quickly.

[0020] In one embodiment, the circuit breaker accessory further comprises:

a handle detection module, connected to a handle of the circuit breaker and configured to detect a position of the handle;
wherein the control module is further configured to:
when the trip arm detection module detects the movement track and the handle is determined as being in an ON state on the basis of the position, determine a state of the circuit breaker as being: a freely tripped state when the handle is blocked;
when the trip arm detection module detects the movement track and the handle is determined as being in an OFF state on the basis of the position, determine a state of the circuit breaker as being: a normally tripped state;
when the trip arm detection module has not detected the movement track and the handle is determined as being in the OFF state on the basis of the position, determine a state of the circuit breaker as being: a manually opened state.

[0021] Clearly, the circuit breaker assembly in embodiments of the present invention can also determine a state of the circuit breaker jointly on the basis of whether the trip arm detection module has detected the movement track of the trip arm, and the handle position detected by the handle detection module.

[0022] In one embodiment, the circuit breaker accessory further comprises:

a first temperature detection module, arranged in a peripheral environment of a thermal system of the circuit breaker and configured to detect a first temperature value;
a second temperature detection module, arranged in a peripheral environment of a contact of the circuit breaker and configured to detect a second temperature value;
wherein the control module is further configured to generate a first alarm prompt for prompting adjustment of a load of the circuit breaker when the first temperature value is greater than a first predetermined threshold; and to generate a second alarm prompt for prompting contact reliability when the second temperature value is greater than a second predetermined threshold.

[0023] Clearly, in embodiments of the present invention, a temperature rise close to a circuit breaker thermal system can be detected, so as to alert the user in advance to adjust a load of the circuit breaker; a temperature rise at a point close to a circuit breaker contact can also be detected, so as to alert the user in advance regarding the contact reliability of the circuit breaker contact.

[0024] In one embodiment, the trip arm detection module comprises: a trip arm connection component, configured to be connected to the trip arm of the circuit breaker; a first magnet, arranged in the trip arm connection component; and a first Hall sensor, arranged at a periphery of a movement track of the trip arm connection component; the handle detection module comprises: a handle connection component, configured to be connected to

the handle of the circuit breaker; a second magnet, arranged in the handle connection component; a second Hall sensor, arranged at a first position at a periphery of a movement track of the handle connection component, wherein the first position corresponds to the handle being in the ON state; and a third Hall sensor, arranged at a second position at a periphery of the movement track of the handle connection component, wherein the second position corresponds to the handle being in the OFF state.

[0025] Clearly, the embodiments of the present invention also propose specific structures of the trip arm detection module and handle detection module, to facilitate implementation.

Brief description of the drawings

[0026]

Fig. 1 is a module diagram of the circuit breaker accessory of the present invention.

Fig. 2 is a structural diagram of the circuit breaker assembly of the present invention.

Fig. 3 is a demonstrative structural diagram of the circuit breaker accessory of the present invention.

Key to the drawings:

[0027]

10	circuit breaker accessory
11	trip arm detection module
12	control module
13	handle detection module
14	first temperature detection module
15	second temperature detection module
16	communication module
17	human-machine interface module
20	circuit breaker assembly
21	circuit breaker
211	trip arm
212	handle
213	thermal system
214	contact
111	trip arm connection assembly
112	first magnet
113	first Hall sensor
131	handle connection assembly
132	second magnet
133	second Hall sensor
134	third Hall sensor
140	first connector of LED
141	second connector of LED
142	MCU
143	communication chip
144	NTC temperature sensor
150	printed circuit board

Detailed description of the invention

[0028] The present invention is explained in further detail below in conjunction with the accompanying drawings and embodiments, to clarify the technical solution and advantages thereof. It should be understood that the particular embodiments described here are merely intended to explain the present invention elaboratively, not to define the scope of protection thereof.

[0029] The solution of the present invention is expounded below by describing a number of representative embodiments, in order to make the description concise and intuitive. The large number of details in the embodiments are merely intended to assist with understanding of the solution of the present invention. However, obviously, the technical solution of the present invention need not be limited to these details when implemented. To avoid making the solution of the present invention confused unnecessarily, some embodiments are not described meticulously, but merely outlined. Hereinbelow, "comprises" means "including but not limited to", while "according to..." means "at least according to..., but not limited to only according to...". In line with the linguistic customs of Chinese, in cases where the quantity of a component is not specified hereinbelow, this means that there may be one or more of the component; this may also be interpreted as meaning at least one.

[0030] The applicant has discovered that: a circuit breaker accessory cooperating with a circuit breaker in the prior art is essentially a purely mechanical device using a micro switch, and therefore can only provide simple information such as circuit breaker off, circuit breaker on and circuit breaker tripped; it is unable to determine the type of circuit breaker tripping. For example, when the circuit breaker is tripped, the circuit breaker accessory in the prior art cannot determine the specific cause of tripping, e.g. cannot determine whether the tripping is caused by residual current or by an overcurrent fault, etc.

[0031] Furthermore, the applicant has also discovered that: when the circuit breaker suffers a fault, the circuit breaker accessory in the prior art cannot realize a pre-

alarm.

[0032] In an embodiment of the present invention, a circuit breaker accessory capable of determining the type of circuit breaker tripping on the basis of a movement track of a trip arm of the circuit breaker is proposed, so as to make it easy for a user to deal with the tripping fault quickly. For example, tripping types include tripping caused by residual current faults, tripping caused by overcurrent faults, etc. Furthermore, the circuit breaker accessory in an embodiment of the present invention can also detect a closed state, an open state and a freely tripped state of the circuit breaker, e.g. manually opened, freely tripped when a handle is blocked, etc.

[0033] In addition, the circuit breaker accessory in an embodiment of the present invention also has a pre-alarm function. For example: a temperature rise close to a circuit breaker thermal system can be detected, so as to alert the user in advance to adjust a load of the circuit breaker; a temperature rise at a point close to a circuit breaker contact can also be detected, so as to alert the user in advance to pay attention to the contact reliability of the circuit breaker contact, etc.

[0034] Fig. 1 is a module diagram of the circuit breaker accessory of the present invention.

[0035] As shown in Fig. 1, the circuit breaker accessory 10 comprises:

> a trip arm detection module 11, connected to a trip arm of the circuit breaker and configured to detect a movement track of the trip arm;
> a control module 12, configured to match the movement track to a preset tripping type track, and determine a tripping type of the circuit breaker on the basis of a matching result.

[0036] Here, one or more tripping type tracks corresponding to one or more tripping types respectively are pre-stored in the control module 12. Once the trip arm detection module 11 has detected the movement track of the trip arm, the control module 12 matches the movement track detected by the trip arm detection module 11 to a pre-stored tripping type track, and determines the tripping type of the circuit breaker on the basis of the matching result.

[0037] For example, a tripping type track corresponding to overcurrent fault tripping is a single-line path; a tripping type track corresponding to residual current fault tripping is a back-and-forth alternating path. An overcurrent fault tripping type track manifested as a single-line path, and a residual current fault tripping type track manifested as a back-and-forth alternating path, are stored in the control module 12. When the trip arm detection module 11 detects that the movement track of the trip arm is a single-line path of movement from a point A to a point B (i.e. not alternating back-and-forth), the control module determines, via a path matching operation, that the circuit breaker tripping type is tripping caused by an overcurrent fault. When the trip arm detection module 11 detects that the movement track of the trip arm is a back-and-forth changing path of movement from point A to point B and then change from point B to point A, the control module determines, via path matching, that the circuit breaker tripping type is tripping caused by a residual current fault.

[0038] Clearly, in embodiments of the present invention, by detecting the movement track of the trip arm of the circuit breaker, it is possible to determine the circuit breaker tripping type, thereby making it easy for the user to determine the cause of the fault quickly.

[0039] In one embodiment, the circuit breaker accessory 10 further comprises a handle detection module 13. The handle detection module 13 is connected to a handle of the circuit breaker, and configured to detect a position of the handle; wherein the control module 12 is further configured to determine a state of the circuit breaker jointly on the basis of whether the trip arm detection module 11 has detected a movement track of the trip arm, and the handle position detected by the handle detection module 13, for example, a freely tripped state when the handle is blocked, a normally tripped state and a manually opened state, etc.

[0040] Here:

> (1) When the control module 12 determines that the trip arm detection module 11 has detected a movement track, and the control module 12 determines that the handle is in an ON state on the basis of the position of the handle, the state of the circuit breaker is determined as being: the freely tripped state when the handle is blocked. Here, when the trip arm detection module 11 detects a movement track, the control module 12 determines that the circuit breaker has tripped. Once the circuit breaker has tripped, the handle should be in an OFF state. However, the control module 12 discovers that the handle is still in the ON state, thus the control module 12 determines that the handle is blocked; in this case, the control module 12 determines that the circuit breaker is in the freely tripped state when the handle is blocked.
>
> (2) When the control module 12 determines that the trip arm detection module 11 has detected a movement track, and the control module 12 determines that the handle is in the OFF state on the basis of the position of the handle, the state of the circuit breaker is determined as being: the normally tripped state. Here, when the trip arm detection module 11 detects a movement track, the control module 12 determines that the circuit breaker has tripped. Once the circuit breaker has tripped, the handle should be in an OFF state. Moreover, the control module 12 discovers that the handle is in the OFF state as is normal, thus the control module 12 determines that the circuit breaker is in the normally tripped state.
>
> (3) When the control module 12 determines that the

trip arm detection module 11 has not detected a movement track, and the control module 12 determines that the handle is in the OFF state on the basis of the position of the handle, the state of the circuit breaker is determined as being: the manually opened state. Here, when the trip arm detection module 11 has not detected a movement track, the control module 12 determines that the circuit breaker has not tripped. Moreover, the control module 12 discovers that the handle is in the OFF state, thus the control module 12 determines that the circuit breaker is in the manually opened state, i.e. the handle of the circuit breaker has been manually set to the OFF state.

[0041] A typical practical example of the state of the circuit breaker being determined jointly on the basis of whether the trip arm detection module 11 has detected a movement track of the trip arm, and the handle position detected by the handle detection module 13, has been described demonstratively above, but those skilled in the art will realize that such a description is purely demonstrative, and not intended to limit the scope of protection of embodiments of the present invention.

[0042] Specifically, the control module 12 may be implemented as comprising one or more central processors or one or more field-programmable gate arrays, wherein the field-programmable gate array integrates one or more central processor cores. Specifically, the central processor or central processor core may be implemented as a CPU, MCU or digital signal processor (DSP), etc.

[0043] In one embodiment, the circuit breaker accessory 10 further comprises: a first temperature detection module 14, arranged in a peripheral environment of a thermal system of the circuit breaker, and configured to detect a first temperature value; wherein the control module 12 is further configured to generate a first alarm prompt for prompting adjustment of a circuit breaker load when the first temperature value is greater than a first predetermined threshold.

[0044] Preferably, the thermal system of the circuit breaker may contain a bimetallic strip. Moreover, the first predetermined threshold is preferably an adjustable empirical value.

[0045] Thus, the circuit breaker accessory in an embodiment of the present invention can detect a temperature rise close to the circuit breaker thermal system, in order to alert the user in advance to adjust the circuit breaker load.

[0046] In one embodiment, the circuit breaker accessory 10 further comprises: a second temperature detection module 15, arranged in a peripheral environment of a contact of the circuit breaker, and configured to detect a second temperature value; wherein the control module 12 is further configured to generate a second alarm prompt for prompting contact reliability when the second temperature value is greater than a second predetermined threshold. Moreover, the second predetermined threshold is preferably an adjustable empirical value.

[0047] Thus, the circuit breaker accessory in an embodiment of the present invention can detect a temperature rise at a point close to the circuit breaker contact, in order to alert the user in advance with regard to the contact reliability of the circuit breaker contact.

[0048] In one embodiment, the trip arm detection module 11 comprises: a trip arm connection component, configured to be connected to the trip arm of the circuit breaker; a first magnet, arranged in the trip arm connection component; and a first Hall sensor, arranged at a periphery of a movement track of the trip arm connection component. Here, the trip arm connection component is connected to the trip arm at the circuit breaker, and the trip arm connection component can move as the trip arm moves. Different tripping faults will cause the trip arm to have different movement tracks, such that the trip arm connection component has correspondingly different movement tracks. The first magnet is inserted into the trip arm connection component. When the trip arm connection component moves with the trip arm, the first Hall sensor will detect a change in the magnetic field of the first magnet, and indirectly detect the movement track of the trip arm on the basis of the change in magnetic field.

[0049] In one embodiment, the handle detection module 13 comprises: a handle connection component, configured to be connected to the handle of the circuit breaker; a second magnet, arranged in the handle connection component; a second Hall sensor, arranged at a first position at a periphery of a movement track of the handle connection component, wherein the first position corresponds to the handle being in the ON state; and a third Hall sensor, arranged at a second position at a periphery of the movement track of the handle connection component, wherein the second position corresponds to the handle being in the OFF state. Here, the handle connection component is connected to the handle at the circuit breaker, and the handle connection component can move as the handle moves. The second magnet is inserted into the handle connection component.

[0050] When the handle moves to the ON state, the handle connection component moves to the first position with the handle, and the second Hall sensor detects that the handle connection component moves to the first position with the handle on the basis of detecting a change in the magnetic field of the second magnet. When the handle moves to the OFF state, the handle connection component moves to the second position with the handle, and the third Hall sensor detects that the handle connection component moves to the second position with the handle on the basis of detecting a change in the magnetic field of the second magnet.

[0051] Typical practical examples of the trip arm detection module and handle detection module have been described demonstratively above. Those skilled in the art will realize that such a description is purely demonstrative, and not intended to limit the scope of protection of embodiments of the present invention.

[0052] In one embodiment, the circuit breaker accessory 10 further comprises a communication module 16; the communication module 16 sends data to a data collector by means of a wireless interface or wired interface.

[0053] Preferably, the data sent by the communication module 16 may comprise: handle position, tripping type, circuit breaker state and temperature rise data, etc. For example, the wired interface comprises at least one of the following: a universal serial bus interface, controller local area network interface or serial port, etc.; the wireless interface comprises at least one of the following: an infrared interface, near field communication interface, Bluetooth interface, Zigbee interface, wireless broadband interface, etc. Preferably, the communication module 16 may be implemented as a communication chip.

[0054] The circuit breaker accessory 10 may further comprise a human-machine interface (HMI) module 17. The HMI module 17 is configured to display to the user the first alarm prompt, second alarm prompt, handle position, tripping type, circuit breaker state and temperature rise data, etc. For example, the HMI module 17 may be implemented as a light emitting diode (LED) or LED array. A button for resetting the circuit breaker accessory may also be provided on the HMI module 17.

[0055] Typical practical examples of the communication module have been described demonstratively above. Those skilled in the art will realize that such a description is purely demonstrative, and not intended to define the scope of protection of embodiments of the present invention.

[0056] Based on the description above, an embodiment of the present invention also proposes a circuit breaker assembly.

[0057] Fig. 2 is a structural diagram of the circuit breaker assembly of the present invention.

[0058] As shown in Fig. 2, the circuit breaker assembly 20 comprises:

a circuit breaker 21, comprising a trip arm 211 and a handle 212;

a circuit breaker accessory 10 as shown in Fig. 1, comprising: a trip arm detection module 11, connected to the trip arm 211 and configured to detect a movement track of the trip arm 211; and a control module 12, configured to match the movement track to a preset tripping type track, and determine a tripping type of the circuit breaker 21 on the basis of a matching result.

[0059] The circuit breaker accessory 10 further comprises: a handle detection module 13, connected to the handle 212 of the circuit breaker and configured to detect a position of the handle 212; wherein the control module 12 is further configured to:

(1) when the trip arm detection module 11 detects a movement track and the handle 212 is determined as being in the ON state on the basis of position, determine the state of the circuit breaker 21 as being: the freely tripped state when the handle is blocked;

(2) when the trip arm detection module 11 detects a movement track and the handle 212 is determined as being in the OFF state on the basis of position, determine the state of the circuit breaker 21 as being: the normally tripped state;

(3) when the trip arm detection module 11 has not detected a movement track and the handle 212 is determined as being in the OFF state on the basis of position, determine the state of the circuit breaker 21 as being: the manually opened state.

[0060] The circuit breaker accessory 10 further comprises: a first temperature detection module 14, arranged in a peripheral environment of a thermal system 213 of the circuit breaker 21, and configured to detect a first temperature value; wherein the control module 12 is further configured to generate a first alarm prompt for prompting adjustment of a circuit breaker load when the first temperature value is greater than a first predetermined threshold.

[0061] The circuit breaker accessory 10 further comprises: a second temperature detection module 15, arranged in a peripheral environment of a contact 214 of the circuit breaker 21, and configured to detect a second temperature value; wherein the control module 12 is further configured to generate a second alarm prompt for prompting contact reliability when the second temperature value is greater than a second predetermined threshold.

[0062] A typical practical example of the circuit breaker accessory 10 is described in detail below with specific electronic components.

[0063] Fig. 3 is a demonstrative structural diagram of the circuit breaker accessory of the present invention.

[0064] In Fig. 3, a circuit breaker accessory as shown in Fig. 1 is arranged in a printed circuit board 150.

[0065] The trip arm detection module of the circuit breaker accessory comprises: a trip arm connection component 111 made of plastic, a first magnet 112 and a first Hall sensor 113. The trip arm connection component 111 is joined to the trip arm at the circuit breaker. The first magnet 112 is inserted into the trip arm connection component 111; the first Hall sensor 113 is arranged on the printed circuit board 150 at a peripheral position of a movement track of the trip arm connection component 111, e.g. arranged at a lower region of the first magnet 112. Different tripping faults will cause the trip arm connection component 111 to have different movement tracks. When the trip arm connection component 111 moves with the trip arm, the first Hall sensor 113 will detect a change in the magnetic field of the first magnet 112, and thereby detect the movement track of the trip arm.

[0066] The handle detection module of the circuit

breaker accessory comprises: a handle connection component 131 made of plastic, a second magnet 132, a second Hall sensor 133 and a third Hall sensor 134. The handle connection component 131 is joined to the handle of the circuit breaker. The second magnet 132 is inserted into the handle connection component 131. The second Hall sensor 133 is arranged on the printed circuit board 150 at a position corresponding to the handle being in the ON state; the third Hall sensor 134 is arranged on the printed circuit board 150 at a position corresponding to the handle being in the OFF state. If the circuit breaker handle moves, the handle connection component 131 will also move correspondingly. The second Hall sensor 133 and third Hall sensor 134 can detect the handle in the ON state or OFF state respectively.

[0067] The control module of the circuit breaker accessory is implemented as an MCU 142. The MCU 142 can determine a tripping type of the circuit breaker on the basis of a movement track detection result of the trip arm detection module, and can also determine a state of the circuit breaker jointly on the basis of whether the trip arm detection module has detected a movement track of the trip arm, and the handle position detected by the handle detection module. For example, when the MCU 142 discovers that the trip arm detection module has detected a movement track (i.e. discovers tripping), and determines that the handle is in the ON state on the basis of the handle position detected by the handle detection module, the MCU 142 identifies free tripping when the handle is blocked.

[0068] An NTC temperature sensor 144 is arranged close to a bimetallic strip of the circuit breaker, in order to acquire a relative temperature of the bimetallic strip. When the NTC temperature sensor 144 detects that the temperature of the bimetallic strip is too high, the MCU 142 issues an alarm prompt by means of an LED connected to the printed circuit board 150 via a first connector 140 and a second connector 141.

[0069] The MCU 142 can also send handle position, tripping type, circuit breaker state and temperature rise data, etc. to a data collector by means of a communication chip 143. The communication chip 143 may be implemented as a Zigbee chip, Bluetooth chip, etc. The MCU 142 can also acquire configuration data from the data collector.

[0070] A typical practical example of the circuit breaker accessory has been described demonstratively above with specific electronic components, but those skilled in the art will realize that the abovementioned electronic components may be subjected to various changes or substitutions; no restrictions are imposed in this regard in embodiments of the present invention. For example, through adjustment of the trip arm connection component 111 made of plastic, a micro switch can replace the first magnet 112 and first Hall sensor 113. Through adjustment of the handle connection component 131 made of plastic, a micro switch can replace the second magnet 132, second Hall sensor 133 and third Hall sensor 134. Furthermore, the NTC temperature sensor 144 may also be replaced by a semiconductor temperature sensor, etc.

[0071] It must be explained that not all of the steps and modules in the flows and structural diagrams above are necessary; certain steps or modules may be omitted according to actual requirements. The order in which steps are executed is not fixed, but may be adjusted as required. The partitioning of the modules is merely functional partitioning, employed for the purpose of facilitating description; during actual implementation, one module may be realized by multiple modules, and the functions of multiple modules may be realized by the same module; these modules may be located in the same device, or in different devices.

[0072] Hardware modules in the embodiments may be realized mechanically or electronically. For example, one hardware module may comprise a specially designed permanent circuit or logic device (such as a dedicated processor, such as an FPGA or ASIC) for completing a specific operation. The hardware module may also comprise a programmable logic device or circuit that is temporarily configured by software (e.g. comprising a general processor or another programmable processor) for executing a specific operation. The choice of whether to specifically use a mechanical method, or a dedicated permanent circuit, or a temporarily configured circuit (e.g. configured by software) to realize the hardware module can be decided according to considerations of cost and time.

[0073] The present invention has been displayed and explained in detail above by means of the accompanying drawings and preferred embodiments, but the present invention is not limited to these disclosed embodiments. Based on the embodiments described above, those skilled in the art will know that further embodiments of the present invention, also falling within the scope of protection of the present invention, could be obtained by combining code checking means in different embodiments above.

Claims

1. A circuit breaker accessory (10), comprising:

a trip arm detection module (11), connected to a trip arm of a circuit breaker and configured to detect a movement track of the trip arm;
a control module (12), configured to match the movement track to a preset tripping type track, and determine a tripping type of the circuit breaker on the basis of a matching result.

2. The circuit breaker accessory (10) as claimed in claim 1, further comprising:

a handle detection module (13), connected to a handle of the circuit breaker and configured to

detect a position of the handle;
wherein the control module (12) is further configured to:

when the trip arm detection module (11) detects the movement track and the handle is determined as being in an ON state on the basis of the position, determine a state of the circuit breaker as being: a freely tripped state when the handle is blocked;
when the trip arm detection module (11) detects the movement track and the handle is determined as being in an OFF state on the basis of the position, determine a state of the circuit breaker as being: a normally tripped state;
when the trip arm detection module (11) has not detected the movement track and the handle is determined as being in the OFF state on the basis of the position, determine a state of the circuit breaker as being: a manually opened state.

3. The circuit breaker accessory (10) as claimed in claim 1 or 2, further comprising:

a first temperature detection module (14), arranged in a peripheral environment of a thermal system of the circuit breaker and configured to detect a first temperature value;
wherein the control module (12) is further configured to generate a first alarm prompt for prompting adjustment of a load of the circuit breaker when the first temperature value is greater than a first predetermined threshold.

4. The circuit breaker accessory (10) as claimed in any one of claims 1 - 3, further comprising:

a second temperature detection module (15), arranged in a peripheral environment of a contact of the circuit breaker and configured to detect a second temperature value;
wherein the control module (12) is further configured to generate a second alarm prompt for prompting contact reliability when the second temperature value is greater than a second predetermined threshold.

5. The circuit breaker accessory (10) as claimed in any one of claims 1 - 4, wherein the trip arm detection module (11) comprises:

a trip arm connection component (111), configured to be connected to the trip arm of the circuit breaker;
a first magnet (112), arranged in the trip arm connection component (111);
a first Hall sensor (113), arranged at a periphery of a movement track of the trip arm connection component (111).

6. The circuit breaker accessory (10) as claimed in any one of claims 2 - 5, wherein the handle detection module (13) comprises:

a handle connection component (131), configured to be connected to the handle of the circuit breaker;
a second magnet (132), arranged in the handle connection component (131);
a second Hall sensor (133), arranged at a first position at a periphery of a movement track of the handle connection component (131), wherein the first position corresponds to the handle being in the ON state;
a third Hall sensor (134), arranged at a second position at a periphery of the movement track of the handle connection component (131), wherein the second position corresponds to the handle being in the OFF state.

7. A circuit breaker assembly (20), comprising:

a circuit breaker (21), comprising a trip arm (211) and a handle (212);
a circuit breaker accessory (10), comprising: a trip arm detection module (11), connected to the trip arm (211) and configured to detect a movement track of the trip arm (211); and a control module (12), configured to match the movement track to a preset tripping type track, and determine a tripping type of the circuit breaker (21) on the basis of a matching result.

8. The circuit breaker assembly (20) as claimed in claim 7, wherein the circuit breaker accessory (10) further comprises:

a handle detection module (13), connected to a handle (212) of the circuit breaker and configured to detect a position of the handle (212);
wherein the control module (12) is further configured to:

when the trip arm detection module (11) detects the movement track and the handle (212) is determined as being in an ON state on the basis of the position, determine a state of the circuit breaker (21) as being: a freely tripped state when the handle is blocked;
when the trip arm detection module (11) detects the movement track and the handle (212) is determined as being in an OFF state on the basis of the position, determine a

state of the circuit breaker (21) as being: a normally tripped state;
when the trip arm detection module (11) has not detected the movement track and the handle (212) is determined as being in the OFF state on the basis of the position, determine a state of the circuit breaker (21) as being: a manually opened state.

9. The circuit breaker assembly (20) as claimed in claim 7 or 8, wherein the circuit breaker accessory (10) further comprises:

a first temperature detection module (14), arranged in a peripheral environment of a thermal system (213) of the circuit breaker (21) and configured to detect a first temperature value;
a second temperature detection module (15), arranged in a peripheral environment of a contact of the circuit breaker (21) and configured to detect a second temperature value;
wherein the control module (12) is further configured to generate a first alarm prompt for prompting adjustment of a load of the circuit breaker when the first temperature value is greater than a first predetermined threshold; and to generate a second alarm prompt for prompting contact reliability when the second temperature value is greater than a second predetermined threshold.

10. The circuit breaker assembly (20) as claimed in claims 8 or 9, wherein
the trip arm detection module (11) comprises: a trip arm connection component (111), configured to be connected to the trip arm (211) of the circuit breaker (21); a first magnet (112), arranged in the trip arm connection component (111); and a first Hall sensor (113), arranged at a periphery of a movement track of the trip arm connection component (111);
the handle detection module (13) comprises: a handle connection component (131), configured to be connected to the handle (212) of the circuit breaker (21); a second magnet (132), arranged in the handle connection component (131); a second Hall sensor (133), arranged at a first position at a periphery of a movement track of the handle connection component (131), wherein the first position corresponds to the handle (212) being in the ON state; and a third Hall sensor (134), arranged at a second position at a periphery of the movement track of the handle connection component (131), wherein the second position corresponds to the handle (212) being in the OFF state.

11. The circuit breaker assembly (20) as claimed in any one of claims 7 - 11, wherein the circuit breaker accessory (10) is implemented according to any one of claims 1-6.

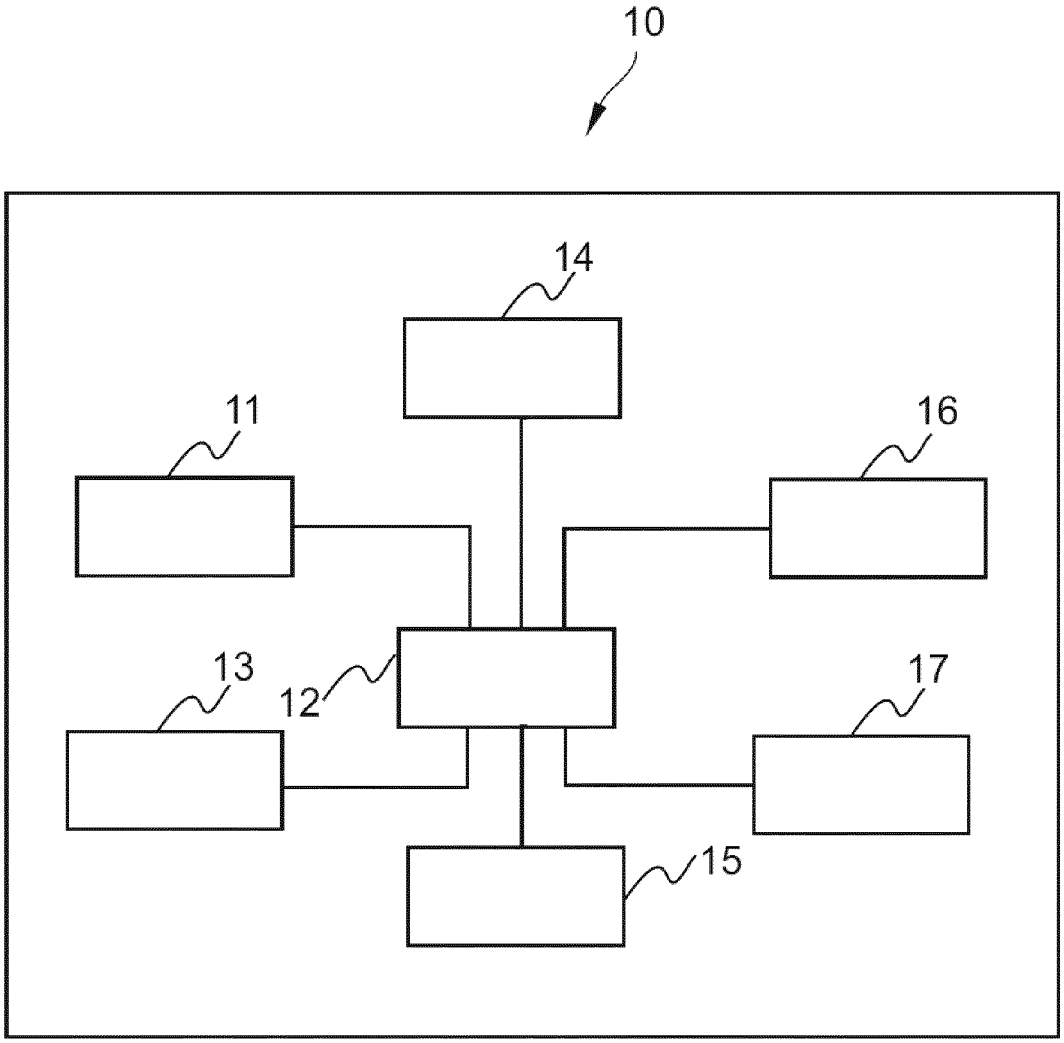

Figure 1

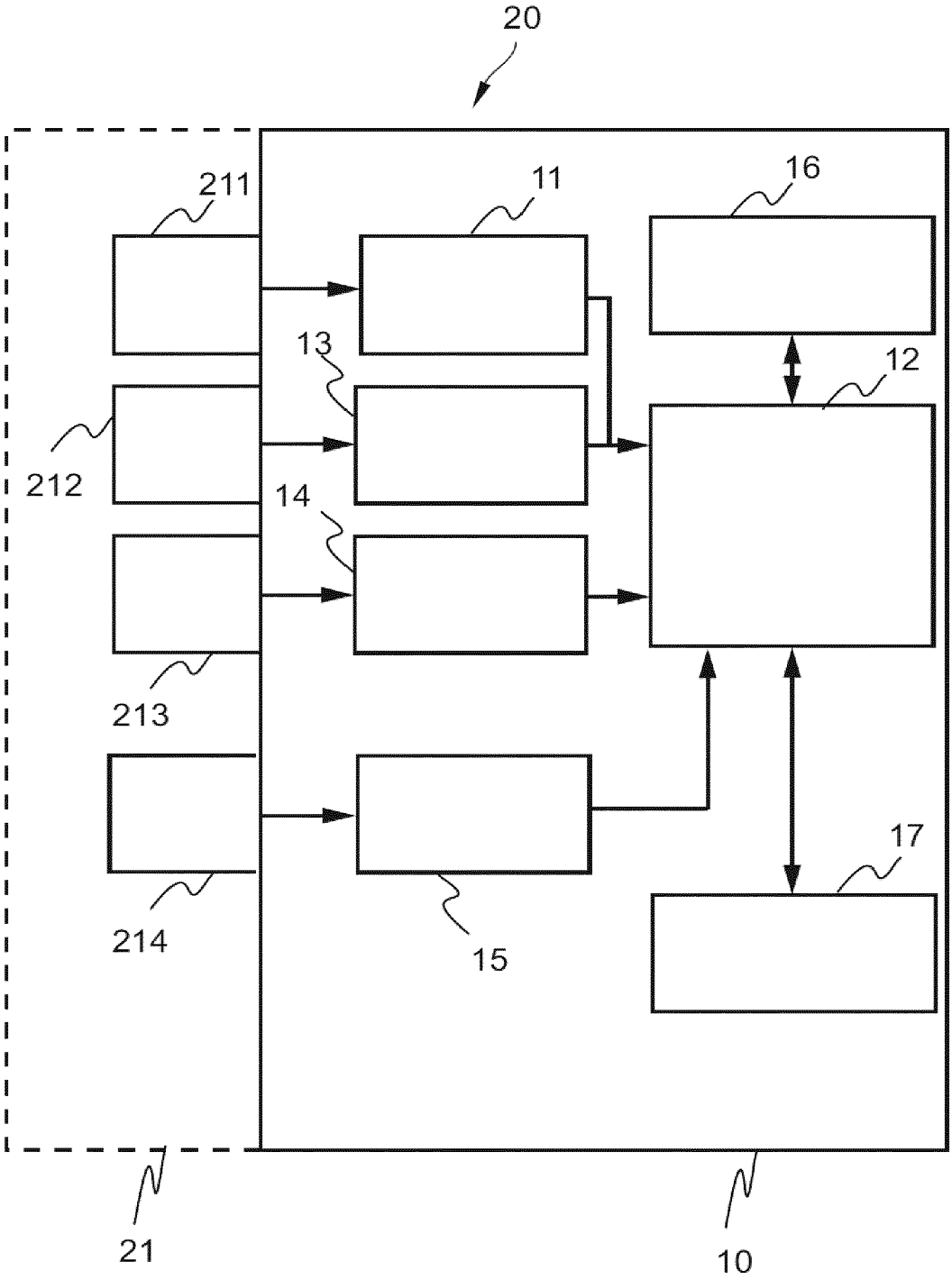

Figure 2

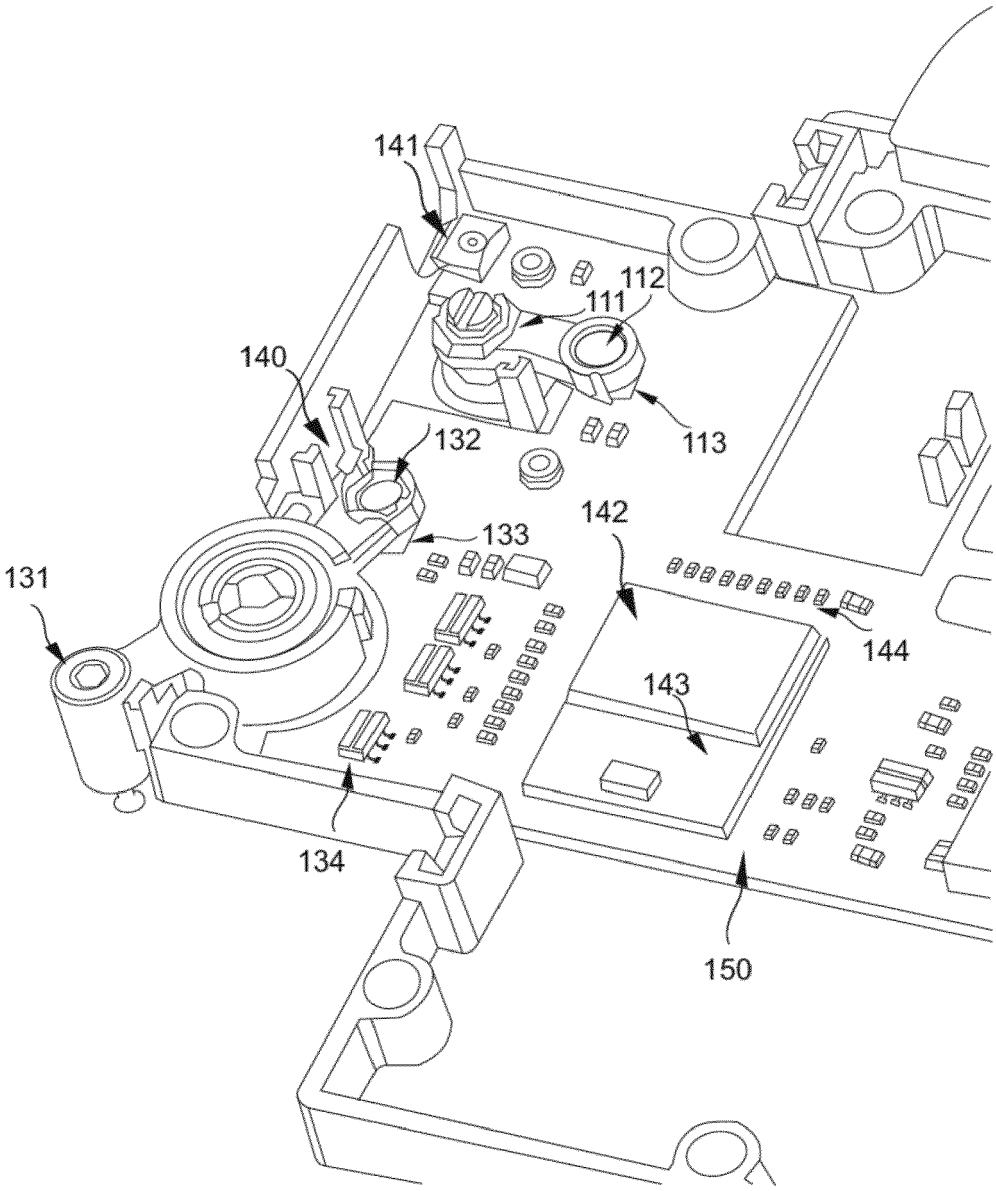

Figure 3

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EUROPEAN SEARCH REPORT

Application Number
EP 21 15 6345

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TECHNICAL FIELDS SEARCHED (IPC)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 May 2021	Findeli, Luc

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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