

ELECTRICAL PROTECTION APPARATUS

Field of the Utility Model

Embodiments of the present utility model relate to an electrical protection apparatus and more specifically to an electrical protection apparatus for overload and/or leakage current protection.

Background of the Utility Model

In an electrical loop, when overload occurs, it exceeds a nominal load of an electrical apparatus itself and causes excessive current. The electrical apparatus generates heat, an insulation level of a circuit will be reduced when the circuit overloads a long period of time, and even the apparatus or circuit will be burned down. When current leakage fault occurs in the electrical apparatus or electrical loop, it might cause dangerous situations such as electric shock or electrical fire. Hence, overload and current leakage protection for the electrical loop is very important.

At present, a circuit protection manner used by a household or building user is generally to install a power distribution cabinet on a wall at the doorway, the power distribution cabinet includes a main circuit breaker and several branch circuit breakers or current leakage protection devices, and each branch circuit breaker or current leakage device protects several sockets.

When an electrical device connected to one of the sockets overloads or short-circuits, the branch circuit breaker in charge of this socket might trip according to an amplitude of current thereof. In another situation, when the leakage current in the protective circuit exceeds a predetermined value, the current leakage protection device in charge of the socket will automatically break off. Both of the above situations make the other electrical devices which are connected to the branch and operating normally be turned off forcedly. This destroys the user's continuity in

power use and reduces the user's experience.

As the living standard raises, the number of sockets in a home or building increases abruptly, correspondingly more circuit breakers and current leakage protection devices need to be used in the power distribution cabinet to take charge of these sockets, and meanwhile a larger power distribution cabinet needs to be equipped. This increases the cost, waste space on the wall and cases mess and difficulty to further maintenance.

Summary of the Utility Model

In view of the problems existing in the prior art, in one aspect, an embodiment of the present utility model provides an electrical protection apparatus, comprising: a current transformer configured to detect the current in a loop; a control circuit configured to determine whether an overload fault occurs in the loop according to the detected current; and a relay configured to perform a switching operation based on a signal from the control circuit.

In an embodiment, the electrical protection apparatus comprises a socket module configured to be coupled with the current transformer, the control circuit and the relay and connected to a panel socket.

In an embodiment, the electrical protection apparatus further comprises an alarm module configured to alarm an overload fault.

In an embodiment, the control circuit is further configured to compare the detected current with a predetermined threshold, and send a trip signal to the relay when the detected current is higher than the predetermined threshold.

In an embodiment, the alarm module is configured to alarm when the controller sends the trip signal to the relay.

In an embodiment, the relay is a bistable state relay.

In an embodiment, the electrical protection apparatus further comprises a reset module configured to restore the relay to a normal working state.

According to another aspect, an embodiment of the present utility model provides an electrical protection apparatus, comprising: a current transformer configured to detect zero-sequence current in a loop; a control circuit configured to determine whether a current leakage fault occurs in the loop according to the detected zero-sequence current; and a relay configured to perform the switching operation based on the signal from the control circuit.

In an embodiment, the electrical protection apparatus comprises a socket module configured to be coupled with the current transformer, the control circuit and the relay and connected to a panel socket.

In an embodiment, the control circuit is further configured to compare the detected zero-sequence current with a predetermined threshold, and send a trip signal to the relay when the detected zero-sequence current is higher than the predetermined threshold.

In an embodiment, the relay is a bistable state relay.

In an embodiment, the electrical protection apparatus further comprises a reset module configured to restore the relay to a normal working state.

According to a further aspect, an embodiment of the present utility model provides an electrical protection apparatus, comprising: a first current transformer configured to detect current in a loop; a second current transformer configured to detect a zero-sequence current in the loop; a control circuit configured to determine whether an overload or current leakage fault occurs in the loop according to the detected current and the detected zero-sequence current; and a relay configured to perform a

switching operation based on a signal from the control circuit.

In an embodiment, the electrical protection apparatus comprises a socket module configured to be coupled to the current transformer, the control circuit and the relay and connected to a panel socket.

In an embodiment, the electrical protection apparatus further comprises an alarm device configured to alarm an overload or current leakage fault.

In an embodiment, the control circuit is further configured to compare the detected current with a first threshold and compare the detected zero-sequence current with a second threshold, and send a trip signal to the relay when the detected current is higher than the first threshold or the detected zero-sequence current is higher than the second threshold.

In an embodiment, the relay is a bistable state relay.

In an embodiment, the alarm device is configured to alarm when the controller sends the trip signal to the relay.

In an embodiment, the electrical protection apparatus further comprises a reset module configured to restore the relay to a normal working state.

The technical solutions proposed by embodiments of the present utility model have characteristics such as convenient use, keeping continuous power usage, beautiful appearance, cost saving, and convenient maintenance.

Brief Description of Drawings

These and other objects, features and advantages will be made apparent upon reading the following detailed depictions of exemplary embodiments with reference to figures. In the figures,

Fig. 1 illustrates a structural schematic view of an electrical protection apparatus according to an embodiment of the present utility model;

Fig. 2a illustrates a front view of an electrical protection apparatus according to an embodiment of the present utility model;

Fig. 2b illustrates a rear view of an electrical protection apparatus according to an embodiment of the present utility model;

Fig. 3 illustrates a schematic view of a circuit of an electrical protection apparatus according to an embodiment of the present utility model;

Fig. 4 illustrates a structural schematic view of an electrical protection apparatus according to another embodiment of the present utility model;

Fig. 5 illustrates a schematic view of a circuit of an electrical protection apparatus according to another embodiment of the present utility model;

Fig. 6 illustrates a structural schematic view of an electrical protection apparatus according to a further embodiment of the present utility model; and

Fig. 7 illustrates a schematic view of a circuit of an electrical protection apparatus according to a further embodiment of the present utility model.

Detailed Description of Preferred Embodiments

Some embodiments of the present utility model are described in detail below with reference to figures.

Fig. 1 illustrates a structural schematic view of an electrical protection apparatus according to an embodiment of the present utility model. The electrical protection apparatus 100 comprises a current transformer 101, a relay 102 and a control circuit 103.

The current transformer 201 is used to detect current in a loop connected with the electrical protection apparatus and send the detected current signal to a control circuit 203. In some embodiment, the detected current signal may be converted to a voltage signal to be sent to the control circuit 203.

The control circuit 203 is configured to determine whether an overload fault occurs in the loop according to the detected current. In some embodiments, the control circuit 203 determines whether the overload fault occurs in the loop by comparing the detected current with a predetermined threshold, and the control circuit 203 further sends a control signal to the relay 202 according to the above determination. When the detected current is lower than the predetermined threshold, the control circuit 203 does not output a control signal, and when the detected current is higher than the predetermined threshold, the control circuit 203 sends a trip signal to the relay 202 to enable the relay to disconnect the loop connected by the electrical protection apparatus.

The relay 202 is configured to perform operation according to a signal from the control circuit 203. In an embodiment, the relay 202 is a bistable state relay.

In some embodiments, the electrical protection apparatus 300 is mounted in a wall box to perform overload protection for an electrical device connected to the wall box. In some embodiments, the electrical protection apparatus may be attached, as an accessory, to other electrical devices to perform overload protection.

In an embodiment, the electrical protection apparatus 300 further comprises a socket module which is used to connect with the electrical device and a panel socket fixed indoor.

In an embodiment, the electrical protection apparatus 200 further comprises an alarm module to indicate occurrence of a fault to the user. In an embodiment, the electrical protection apparatus 200 further comprises a reset module to restore the relay 202 to a

normal working state.

Fig. 2a illustrates a front view of an electrical protection apparatus 200 according to an embodiment of the present utility model. As shown in the figure, the electrical protection apparatus 200 according to an embodiment of the present utility model comprises a housing 201, a socket panel 202 and a reset module 203. The electrical protection apparatus may be connected to various electrical devices via insertion holes in the socket panel 202 on the housing 201. The insertion holes on the housing are usually adapted for a plug of the electrical device, and the insertion holes may have different shapes depending on different countries and regions.

Fig. 2b illustrates a rear view of an electrical protection apparatus 200 according to an embodiment of the present utility model. As shown in the figure, the housing 201 of the electrical protection apparatus 200 in the embodiment of the present utility model comprises a plug 204. The electrical protection apparatus may be connected to a panel socket on a wall of a home and building via the plug 203. The insertion hole panel 202 and the plug 204 on a rear side as shown in Figs. 2a and 2b may be included in the socket module of the electrical protection apparatus.

In some embodiments, the plug of the electrical protection apparatus is located on one side of the housing, and the other side of the housing comprises an insertion hole for receiving a plug of another electrical device. The electrical protection apparatus may be an adapter directly used on an individual socket.

Fig. 3 illustrates a schematic view of a circuit of an electrical protection apparatus according to an embodiment of the present utility model. P in Fig. 3 represents a phase line (live wire) in municipal power supply connected by the electrical protection apparatus, and N represents a null line. As shown in Fig. 3, the current transformer 301 is used to measure current in one connected phase and send the detected current to the control circuit 303.

The control circuit 303 comprises a comparator (comp) which compares the detected current in one phase with a predetermined threshold. Furthermore, the control circuit 303 is further connected with a relay 302, and sends a signal output by the comparator to the relay 302.

In an embodiment, the control circuit 303 may be a MCU (microcontroller), and a power source voltage of the control circuit 303 is obtained by directly taking a voltage at a point of P pole and N pole, and reducing and rectifying this voltage. A resistor R in the figure is used to limit overcurrent.

When the detected current in P pole is higher than the predetermined threshold, the control circuit 303 sends a trip signal to the controller 302, and the controller 302 enables a switch 306 connected with the circuit to act to cut off the loop.

In an embodiment, the electrical protection apparatus further comprises a reset module 305. The reset module 305 sends a reset signal when the user triggers the switch in the module, the reset signal is input to the control loop 203 via a connection line, the control loop 203, after obtaining the signal, outputs to access the relay 202 to enable the relay 202 to restore to a normal working state.

In an embodiment, the electrical protection apparatus further comprises an alarm module (not shown). The alarm module may be connected to the control loop 203; when the detected current in P pole is higher than a predetermined threshold, the control circuit 303 sends a trigger signal to the alarm module to make it send an alarm to the user. In this case, the control circuit 303 may not automatically send a trip signal to the relay 302, but determines whether to cut away the faulty circuit according to the user's instruction. If the user does not want to cut away the faulty circuit, the control circuit 303 stops outputting a signal to the relay 302. If the user inputs cutting away the faulty circuit, the controller 303 outputs a trip signal to the relay 303 to cut off the faulty circuit.

In some embodiments, the electrical protection apparatus further comprises an EMC (electromagnetic compatibility) protective circuit to ensure normal operation of the control circuit 303.

Fig. 4 illustrates a structural schematic view of an electrical protection apparatus according to another embodiment of the present utility model. The electrical protection apparatus 200 comprises a zero-sequence current transformer 401, a relay 402 and a control circuit 403.

The current transformer 401 is used to detect zero-sequence current in a loop connected with the electrical protection apparatus and send the detected zero-sequence current signal to the control circuit 403. In some embodiment, the detected zero-sequence current signal may be converted to a voltage signal to be sent to the control circuit 403.

The control circuit 403 is configured to determine whether a current leakage fault occurs in the loop according to the detected current. In some embodiments, the control circuit 403 determines whether the fault occurs in the loop by comparing the detected zero-sequence current with a predetermined threshold, and the control circuit 403 further sends a control signal to the relay 402 according to the above determination. When the detected current is lower than the predetermined threshold, the control circuit 403 does not output a control signal, and when the detected current is higher than the predetermined threshold, the control circuit 403 sends a trip signal to the relay 402 to enable the relay to disconnect the loop connected by the electrical protection apparatus.

The relay 402 is configured to perform operation according to a signal from the control circuit 403. In an embodiment, the relay 402 is a bistable state relay.

In some embodiments, the electrical protection apparatus 400 is mounted in a wall box to perform overload protection for an electrical device connected to the wall box.

In some embodiments, the electrical protection apparatus may be attached, as an accessory, to other electrical devices to perform overload protection.

In an embodiment, the electrical protection apparatus 400 further comprises a socket module which is used to connect with the electrical device and a panel socket fixed indoor. The socket module comprises the insertion hole panel 202 and the plug 204 on a rear side as shown in Figs. 2a and 2b.

In an embodiment, the electrical protection apparatus 400 further comprises a reset module to enable the relay 402 to restore to a normal working state.

Fig. 5 illustrates a schematic view of a circuit of an electrical protection apparatus according to another embodiment of the present utility model. P in Fig. 5 represents a phase line (live wire) in municipal power supply connected by the electrical protection apparatus, and N represents a null line. As shown in Fig. 5, the zero-sequence current transformer 501 is used to measure zero-sequence current in one connected loop and send the detected zero-sequence current to the control circuit 503.

The control circuit 503 comprises a comparator (comp) which compares the detected zero-sequence current with a predetermined threshold. Furthermore, the control circuit 503 is further connected with a relay 502, and sends a signal output by the comparator to the relay 502.

In an embodiment, the control circuit 503 may be a MCU (microcontroller), and a power source voltage of the control circuit 503 is obtained by directly taking voltage at a point of P pole and N pole, and reducing and rectifying this voltage. A resistor R in the figure is used to limit overcurrent.

When the detected zero-sequence current is higher than the predetermined threshold, this indicates occurrence of a current leakage fault, and the control circuit 503 sends a trip signal to the controller 502, and the controller 502 enables a switch 506 connected

with the circuit to act to cut off the loop.

In an embodiment, the electrical protection apparatus further comprises a reset module 505. The reset module 505 sends a reset signal when the user triggers the switch in the module, the reset signal is input to the control loop 503 via a connection line, the control loop 503, after obtaining the signal, outputs to access the relay 502 to enable the relay 502 to restore to a normal working state.

In some embodiments, the electrical protection apparatus further comprises an EMC (electromagnetic compatibility) protective circuit to ensure normal operation of the control circuit 303.

Fig. 6 illustrates a structural schematic view of an electrical protection apparatus according to a further embodiment of the present utility model. The electrical protection apparatus 600 comprises a first current transformer 601, a second current transformer 602, a relay 603 and a control circuit 604.

The first current transformer 601 and the second current transformer 602 are respectively used to detect current and zero-sequence current in a loop connected with the electrical protection apparatus and send the detected current and zero-sequence current signal to the control circuit 603. In some embodiment, the detected current or zero-sequence current signal may be converted to a voltage signal to be sent to the control circuit 604.

The control circuit 604 is configured to determine whether an overload or current leakage fault occurs in the loop according to the detected current and zero-sequence current. In some embodiments, the control circuit 604 determines whether the fault occurs in the loop by comparing the detected current with a first threshold and comprising the detected zero-sequence current with a second threshold, and the control circuit 604 further sends a control signal to the relay 603 according to the above determination. When the detected current is lower than the first threshold and

the zero-sequence current is lower than the second threshold, the control circuit 403 does not output a control signal, and when the detected current is higher than the first threshold (indicating occurrence of the overload fault) or the zero-sequence current is higher than the second threshold (indicating occurrence of current leakage fault), the control circuit 604 sends a trip signal to the relay 603 to enable the relay 603 to disconnect the loop connected by the electrical protection apparatus.

The relay 603 is configured to perform operation according to a signal from the control circuit 604. In an embodiment, the relay 603 is a bistable state relay.

In some embodiments, the electrical protection apparatus 600 is mounted in a wall box to perform overload protection for an electrical device connected to the wall box. In some embodiments, the electrical protection apparatus may be attached, as an accessory, to other electrical devices to perform overload protection.

In an embodiment, the electrical protection apparatus 600 further comprises a socket module which is used to connect with the electrical device and a panel socket fixed indoor. The socket module comprises the insertion hole panel 202 and the plug 204 on a rear side as shown in Figs. 2a and 2b.

In an embodiment, the electrical protection apparatus 600 further comprises a reset module to enable the relay 402 to restore to a normal working state. In an embodiment, the electrical protection apparatus 600 further comprises an alarm module to indicate occurrence of a fault to the user.

Fig. 7 illustrates a schematic view of a circuit of an electrical protection apparatus according to a further embodiment of the present utility model. As shown in Fig. 7, a first current transformer 701 is used to measure a current flowing through P phase in a connected loop, and a second current transformer 702 is used to measure a zero-sequence current in the connected loop and sends the detected zero-sequence current to the control circuit 704.

The control circuit 704 comprises two comparators which respectively compare the detected current with a first threshold, and compare the detected zero-sequence current with a second threshold. Furthermore, the control circuit 704 is further connected with the relay 703 and sends a signal outputted by the comparator to the relay 703. Upon occurrence of any one of cases in which the detected current indicates an overload fault or the detected zero-sequence current indicates the current leakage fault, the control circuit 704 sends a trip signal to the relay 703 to cut off the loop.

In an embodiment, the control circuit 704 may be a MCU (microcontroller), and a power source voltage of the control circuit 704 is obtained by directly a voltage at a point of P pole and N pole, and reducing and rectifying this voltage. A resistor R in the figure is used to limit overcurrent.

In an embodiment, the electrical protection apparatus further comprises a reset module 706. The reset module 706 sends a reset signal when the user triggers a switch in the module, the reset signal is input to a control loop 703 via a connection line, the control loop 704, after obtaining the signal, outputs to access the relay 703 to enable the relay 703 to restore to a normal working state. The reset module may be formed in the form of a button as denoted by 103 shown in Fig. 1a. In other applications, the reset module may also be formed in any other suitable shape or manner.

In an embodiment, the electrical protection apparatus further comprises an alarm module (not shown). The alarm module may be connected to the control loop 704; when the detected current in P pole is higher than a predetermined threshold, the control circuit 704 sends a trigger signal to the alarm module to make it send an alarm to the user to display occurrence of the overload fault. In this case, the control circuit 704 may not send a trip signal to the relay 703, but determines whether to cut away the faulty circuit according to the user's instruction. If the user does not want to cut away the faulty circuit, the control circuit 704 stops outputting a signal to the

relay 703. If the user wants to cut away the faulty circuit, the controller 704 outputs a trip signal to the relay 703 to cut off the faulty circuit. In some embodiments, the alarm module is configured to send an alarm when the controller sends the trip signal to remind the user of occurrence of the overload fault or current leakage fault. In some embodiment, different alarm display manners are used in the overload fault or current leakage fault to help the user to judge which fault occurs.

In some embodiments, the electrical protection apparatus further comprises an EMC (electromagnetic compatibility) protective circuit to ensure normal operation of the control circuit 303.

In some embodiments, a power distribution protection apparatus for a home or a building comprise a main circuit breaker matching with a plurality of electrical protection apparatuses installed on the panel socket according to embodiments of the present utility model. According to upper-lower level matching principle of the circuit breaker, a predetermined threshold in the electrical protection apparatus according to an embodiment of the present utility model is greater than a rated value of a higher-level switching apparatus of the circuit breaker. The upper-level switching apparatus may be a circuit breaker in a power distribution cabinet.

Embodiments of the present utility model are characterized by convenient use and plug and play, and may provide an independent power use loop protection solution, and ensure continuity of power use. Furthermore, embodiments according to the present utility model may save high conductor wire cost caused by a plurality of circuit breakers installed in the power distribution cabinet and the cost of circuit breakers. Furthermore, a larger power distribution cabinet is not needed any longer to install many circuit breakers to independently control sockets mounted on a wall, thereby avoiding incurrence of high expenditure for purchasing conductor wires and power distribution cabinet, saving space on the wall, facilitating subsequent maintenance and avoiding too many long conductor wires in the wall body and resultant mess and maintenance difficulty.

It should be appreciated that to make embodiments of the present utility model easier to understand, the above depictions omit some more specific technical details which are well known for those skilled in the art and might be requisite for implementation of embodiments of the present utility model.

Although specific embodiments of the present utility model have already been disclosed, those skilled in the art appreciate that modifications may be made to specific embodiments without departing from the spirit and scope of the present utility model. Hence, the present utility model is not limited to specific embodiments, and the appended claims include any and all such applications, modifications and implementations in the scope of the present utility mode.

CLAIMS

1. An electrical protection apparatus, characterized in that it comprises:
a current transformer configured to detect a current in a loop;
a control circuit configured to determine whether an overload fault occurs in the loop according to the detected current;
a bistable state relay configured to perform a switching operation based on a signal from the control circuit;
a socket module configured to be coupled with the current transformer, the control circuit and the bistable state relay and to be connected to a panel socket; and
an alarm module configured to alarm an overload fault,
wherein the control circuit sends the signal to the bistable state relay in response to receiving an instruction from a user to cut away the loop after determining an overload fault occurs in the loop.

2. The electrical protection apparatus according to claim 1, characterized in that the control circuit is further configured to compare the detected current with a predetermined threshold, and send a trip signal to the bistable state relay when the detected current is higher than the predetermined threshold.

3. The electrical protection apparatus according to claim 2, characterized in that the alarm module is configured to alarm when the controller sends the trip signal to the bistable state relay.

4. The electrical protection apparatus according to claim 1, characterized in that the electrical protection apparatus further comprises a reset module configured to restore the bistable state relay to a normal working state.

5. An electrical protection apparatus, characterized in that it comprises:
a current transformer configured to detect a zero-sequence current in a loop;
a control circuit configured to determine whether a current leakage fault occurs in the loop according to the detected zero-sequence current;
a bistable state relay configured to perform a switching operation based on a signal

from the control circuit;

a socket module configured to be coupled with the current transformer, the control circuit and the bistable state relay and to be connected to a panel socket; and

an alarm module configured to alarm a current leakage fault,

wherein the control circuit sends the signal to the bistable state relay in response to receiving an instruction from a user to cut away the loop after determining an overload fault occurs in the loop.

6. The electrical protection apparatus according to claim 5, characterized in that the control circuit is further configured to compare the detected zero-sequence current with a predetermined threshold, and send a trip signal to the bistable state relay when the detected zero-sequence current is higher than the predetermined threshold.

7. The electrical protection apparatus according to claim 5, characterized in that the electrical protection apparatus further comprises a reset module configured to restore the bistable state relay to a normal working state.

8. An electrical protection apparatus, characterized in that it comprises:

a first current transformer configured to detect a current in a loop;

a second current transformer configured to detect a zero-sequence current in the loop;

a control circuit configured to determine whether an overload fault or a current leakage fault occurs in the loop according to the detected current and the detected zero-sequence current;

a bistable state relay configured to perform a switching operation based on a signal from the control circuit;

a socket module configured to be coupled with the current transformer, the control circuit and the bistable state relay and to be connected to a panel socket; and

an alarm device configured to alarm an overload or current leakage fault,

wherein the control circuit sends the signal to the bistable state relay in response to receiving an instruction from a user to cut away the loop after determining an overload fault occurs in the loop.

9. The electrical protection apparatus according to claim 8, characterized in that the control circuit is further configured to compare the detected current with a first threshold and compare the detected zero-sequence current with a second threshold, and send a trip signal to the bistable state relay when the detected current is higher than the first threshold or the detected zero-sequence current is higher than the second threshold.

10. The electrical protection apparatus according to claim 8, characterized in that the alarm device is configured to alarm when the controller sends the trip signal to the bistable state relay.

11. The electrical protection apparatus according to claim 8, characterized in that the electrical protection apparatus further comprises a reset module configured to restore the bistable state relay to a normal working state.