

PROTECTION RELAY WITH MECHANICAL TRIP BUTTON

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

The present invention relates to a digital protection relay, and more particularly to a protection relay equipped with a mechanical trip button which will, in the course of a tripping, pop-out and latch with output contacts.

2. Related Background Art

10 In electrical engineering, protection relay is a device designed to operate in the event of a fault by closing a set of contacts. This results in energizing of a shunt trip coil of the circuit breaker which then open the circuit breaker and disconnects the fault. The presence of the fault is detected by a measuring instrument such as current transformers, and/or voltage transformers.

15 A protection relay functions by measuring the input energizing quantities from a measuring instrument, and through a signal processing module, such energizing quantities be processed into a digital signal and will be compared with a threshold setting value. If the energizing quantities are higher than the threshold setting value, for instance in the case of overcurrent protection, the protection relay will pick up the detection, and a delay timer will start to
20 countdown, and once the delay timer is elapsed, the protection relay will operate the output tripping contact, and a light indication of the trip status will be lighted.

In conventional protection relay without a mechanical trip button, in a certain scenario after a tripping event, the protection relay will lost its auxiliary power supply. Under such a condition, the protection relay will be powered off after it loses its auxiliary power supply. The operator
25 finds all the protection relay in the switchboard being in OFF mode, the operator cannot identify which of the protection relay has been operated. In addition, for the particular protection relay which operated and is powered off, this protection relay output tripping contact will revert into its normal state. This allows the operator to re-energize the circuit breaker without able to identify the fault or resetting protection relay. Furthermore re-energizing the circuit breaker
30 without isolated the fault can cause a life threatening to the operator.

A prior art multifunction protective relay incorporates many protective functions in a single relay where an analog signal-processing hardware is replaced with a digital signal processor (DSP), as disclosed in US Patent No. 5,224,011. The voltage and current input signals of the

relay proposed in the patent are modelled as sinusoidal signals which may be affected by dc offset and harmonic components. These voltage and current input signals are of various parameters, namely, rms value, peak value and frequency of the fundamental frequency component. These various parameters of the input signals are estimated using digital signal-
5 processing algorithms.

PCT Publication No. WO2009101463A1 discloses a process of configuring a standalone self-supplied numeric controlled relay for providing phase and earth over current protection to electrical systems by accurate current measurement. The arrangement for current measurement with control algorithms is provided for power control by providing amplified and
10 conditioned current for optimization between the current necessary to power an electronic circuit and the fidelity of a measured current waveform so that they both are at the acceptable levels at the same time. This invention disclosure describes the current sensing and associated algorithm for power control in a truly self- powered relay.

China Patent No. CN101097818A entitled "Distance protection relay and method" discloses a
15 protective relay for an electrical power distribution system. The protective relay comprises first and second current transformers arranged to sense a respective current flowing into a power line, and a voltage sensing device arranged to sense the voltage of the power line. The protective relay further comprises a first and a second device for determining the direction of a fault within the system based on a current signal from the first and second current
20 transformers and a voltage signal from the voltage sensing means. The protective relay further comprises a third device for determining the fault direction based on a sum of the current signals from the first and second current transformers and a voltage signal from said voltage sensing means. Controller means determines whether a fault is internal or external based on the fault directions determined by the first, second and third devices. The invention also relates
25 to a corresponding method.

A problem inherent in the conventional digital protective relay described is that a larger number of processes are needed and need to be adjusted with the variable resistance when in the manufacturing process of the digital protective relay, and that a great number of electronic parts are required for decoding, resulting in an increase in cost. Conventional protection relays
30 are not able to differentiate the tripping action whether it is caused by an actual trip or by a test trip.

SUMMARY OF THE INVENTION

It is a main object of the present invention to provide a digital protection relay (100) connected to a shunt trip coil (30) of a circuit breaker (24) and a current transformers (26) comprising:

a signal processing module (10) for converting energizing quantities from a measuring instrument (current transformer in the case of an overcurrent protection relay) into a digital value and for comparing this input energizing quantities with a threshold setting value;

a mechanical trip button (18) being latched with output tripping contact (20) connected to a shunt trip coil (30) of the circuit breaker (24);

a timer (16) linked to a pick-up signal device (14) for inputting a time delay (17);

a comparator (12) containing a threshold setting value for comparing with input energizing quantities;

an event recorder (82) for storing a tripping event, and

a real time clock (84) is linked to event recorder (82) for inputting a time reference for event recording.

thereby the operation of the output tripping contact will energize and cause the circuit breaker to trip and the mechanical trip button to pop out.

It is a primary object of the present invention to provide a digital protection relay, wherein a built-in mechanical trip button and a LED trip status indicator are provided, and in the event of protection relay operates, the LED trip status indicator will light up, the mechanical trip button will pop out and the output tripping contact on will change its state.

Another object of the present invention is to provide a digital protection relay, wherein the mechanical trip button is latched with the output tripping contact, and remains at its position even without any auxiliary power supply.

Yet another object of the present invention is to provide a digital protection relay, wherein the mechanical trip button is physically reset, and once it is reset, the output tripping contact of the protection relay will revert back to the original state.

Another object of the present invention is to provide a digital protection relay, wherein the protection relay is able to differentiate a tripping event whether the tripping is caused by an actual trip or by a test trip.

Still a further object of the present invention is to provide a protection relay, wherein in the event that all the protection relays are switched off due to the loss of its auxiliary power supply, the user can easily identify which of the protection relay has operated by looking at the mechanical trip button.

- 5 Further object of the present invention is to provide a protection relay, wherein in the event when the auxiliary power supply is lost, the output tripping contact of the protection relay will remain at its state as long as the mechanical trip button is still in its pop out position.

Still yet another object of the present invention is to provide a protection relay, wherein the mechanical trip button prevents the user to re-energize the circuit breaker without resetting
10 the protection relay.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing a protection relay equipped with a mechanical trip button in accordance with the preferred embodiment of the present invention.

FIG. 2A is a front view of the protection relay of the preferred embodiment in accordance with
15 the present invention.

FIG. 2B is a side elevation view of the protection relay of the preferred embodiment in accordance with the present invention.

FIG. 2C is a rear view of the of the protection relay of the preferred embodiment in accordance with the present invention, which is a terminal block of the protection relay.

20 FIG. 3 is a schematic view showing the installation of the protection relay to a circuitry system in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning to the FIGURE, there is shown a protective relay (100) constructed according to the teachings of the present invention. The protection relay (100) comprises a signal processing
25 module (10), a comparator (12), a pick-up signal function (14), and a delay timer (16). A current transformer (51) generates an input to be delivered to the signal processing module (10) of the protection relay (100). In accordance with the present invention, the protection relay (100) functions as a device in measuring the input energizing quantities, and the signal processing module (10) to convert the input energizing quantities into a corresponded digital
30 signal (11). The corresponded digital signal of the energizing quantities (11) is used to

compare with a threshold setting value (13) within the comparator (12). If the energizing quantities (11) are of higher than the threshold setting value (13), then the protection relay (100) will pickup the signal, and the delay timer (16) is triggered to count down. Once a timing of the delay timer (16) is elapsed, the protection relay (100) will operate the output tripping contact (61), and will initiate a trip status indication.

In accordance with the present invention, the output tripping contact (61) of the protection relay (100) is connected to a shunt trip coil (30) of the circuit breaker (24). Once the output tripping contact (61) is operated, the shunt trip coil (30) will energize and cause the circuit breaker (24) to trip.

In the course of a situation where it is an overcurrent, earth fault or an earth leakage protection relay, the input energizing quantities (51) to the protection relay (100) are the secondary current from the current transformers (26). The input energizing quantities are then converted into the corresponded digital signal via the signal processing module (10). The digitized energizing quantities is then delivered to the comparator (12) to be compared with the threshold setting value (13), preset in the comparator (12).

The protection relay (100) of the present invention has a built-in mechanical trip button (18) and a LED trip status indicator (38). In the course of an operation of the protection relay (100), the LED trip status indicator (38) of the protection relay (100) will light up, and the mechanical trip button (18) will pop out and the output tripping contact (61) will operate and change its state.

FIG. 1 shows a block diagram indicating a protection relay (100) equipped with a mechanical trip button (62) in accordance with the preferred embodiment of the present invention. As shown, the measuring signal from a current transformer (51), which the secondary current of the current transformer is then input to the signal processing module (10). The input from the current transformer (51) is a RMS value of the electrical current. The test trip (52) is an input into the protection relay (100) and is used to simulate an operation of the protection relay (100). The protection relay (100) will change from a normal state into an operated state after the test trip being simulated. The reset (53) is an input signal into the protection relay (100) which is use to reset the protection relay from the operated state back to the normal state of the protection relay.

As shown in the figure, the signal processing module (10) starts to process the input measuring signal into a digital signal which is readable by a microprocessor within the protection relay (100). The energizing quantities (11) are the digitized measuring signals after

being processed in the signal processing module (10), and these quantities are the RMS value of the electrical current for earth fault and earth leakage protection relay. The comparator (12) compares the energizing quantities (11) with a threshold setting value. When the energizing quantities are higher than the threshold setting value, the output of the comparator (12) will be triggered. The pick-up signal function (14) is the output of the comparator without any time delay. The timer (16) is a delay timer for user to set the timing, when the relay shall operate if the measuring signal is higher than the threshold setting value. In the preferred embodiment of the present invention, there are two types of delay time, definite time delay and inverse time delay. The definite time delay is the relay that will operate or trip at a definite delay time. The inverse time delay is the relays' operates or trip time being inversely proportional to the fault current or input measuring signal. The higher the input measuring signal, the shorter the delay time.

The event recorder (82) records the date, the time, and the magnitude of the tripping event of the protection relay (100). The real time clock (84) provides the protection relay (100) the actual date and time for event recording. The output tripping contact (61) is an output contact for tripping. The output tripping contact will connect to a shunt trip coil of a circuit breaker. The mechanical trip button (62) is a unique tripped indication button in the present invention. The mechanical trip button (62) will pop out once the protection relay (100) is in operated state. The mechanical trip button (62) is latched with the output tripping contact (61). The other binary output signals are the output signals for other use, i.e. for building monitoring system (BMS), programmable logic control (PLC), and etc.

The event recorder (82) has the function to differentiate an actual trip or a test trip if a tripping is being triggered. In other words, the protection relay (100) of the present invention has the ability to differentiate a tripping event whether it is either caused by an actual trip or by a test trip which can be triggered intentionally or unintentionally.

FIG. 2A is a front view of the protection relay of the preferred embodiment in accordance with the present invention.

FIG. 2B is a side elevation view of the protection relay of the preferred embodiment in accordance with the present invention.

FIG. 2C is a rear view of the of the protection relay of the preferred embodiment in accordance with the present invention, which is a terminal block of the protection relay.

As shown in the figure, the trip indication light (38) is lighted which shows the tripped status of the protection relay (100). On other words, the trip indication light (38) will light up when the

protection relay (100) is in an operated state. The test trip button (28) on the protection relay (100) is used to input into the protection relay (100) to simulate a test trip of the protection relay (100). The protection relay (100) will change from the normal state into an operated state after the test trip button (28) is pressed. The display (60) of the protection relay (100) is used to display data, for instance, the live reading, the threshold setting value, the time delay setting value, real time clock and the recorded events.

The navigation buttons (62) are buttons for user to change the viewing of display data, to view and change parameters setting or to view the recorded events of the protection relay (100). The mechanical trip button (18) is a unique tripped indication button. The mechanical trip button (18) is pop-out once the protection relay (100) is in operated state. In the preferred embodiment, the mechanical trip button (18) is latched with the output tripping contact (20).

The terminal block (64) is located at the rear end of the protection relay (100) and is used to secure and terminates wires that connect with the protection relay (100). The auxiliary power supply (22) is used for powered up the protection relay (100). As mentioned earlier, the input energizing quantities are the secondary current from the current transformers (51). It is the measuring signal from a current transformers, which is a RMS value of the electrical current. The output tripping contact (20) is designed for tripping the circuit breaker when the energizing quantities are higher than the threshold setting value. Usually, the output tripping contact output (20) is connected to the shunt trip coil (30) of the circuit breaker (24).

FIG. 3 is a schematic view showing the installation of the protection relay to a circuitry system in accordance with the present invention. As indicated in the figure, the current transformer (26) is measuring instrument, used to measure the electrical current. The secondary current of the current transformer is proportional to its primary current based on the ratio. For example, a 1,000/5A current transformer, where there is a 1,000A flow in the primary, the secondary output current will be 5A. The circuit breaker is an electrical switch designed to protect an electrical circuit from damage caused by excess current from an overload or short circuit. In the figure, the incoming supply (20) is power supply into the electrical panel, and the outgoing feeders (28) is load connected into this electrical panel. The shunt trip device in the preferred embodiment is an optional accessory in the circuit breaker that mechanically trips the circuit breaker when the power is applied to the shunt trip terminals. Overall the protection relay is designed to trip a circuit breaker when a fault is detected.

The auxiliary power supply is used for powered up the protection relay (100).

FIG. 2A – FIG 2C show the protection relay in accordance with the present invention. FIG. 2A is the front view of the protection relay. On the front panel of the protection relay is a central display (60), which is used to indicate instance value of the circuitry, for example it will be a phase current value for an overcurrent protection relay, an earth fault current value for an earth fault protection, earth leakage value for an earth leakage protection relay. On the front panel of the protection relay, there is a tripped indicative light (38) and a test trip button (28) located next to the tripped indicative light (38).

On the front panel of the protection relay (100), a mechanical trip button (18) is located at one corner thereof. Next to the mechanical trip button (18), there is a plurality of navigation buttons (62) which are used for the browsing of data to be displayed on the display (60). The navigation buttons (62) are button to scroll upward, downward, left and right.

FIG. 2B shows the side view of the protection relay (100). The rear portion of the protection relay (100) is a terminal block (60) which is used to be connected the protection relay (100) onto other circuits (not shown, i.e. current transformer, shunt trip coil of circuit breaker, etc). The mechanical trip button (18) is protruded out from the panel of the protection relay (100).

FIG. 2C shows the terminal block (60) of the protection relay (100) and the terminal block (60) having a plurality of slots shall be connected to a plurality of devices such as an auxiliary power supply (22), the secondary of the current transformer (51), an output tripping contact (20) to the shunt trip coil of a circuit breaker.

Referring to FIG. 3, there is shown that the protection relay (100) is connected to a shunt trip coil (30). The shunt trip coil (30) is an electrical component that is used to open the circuit breaker (24) when the coil has been energized. When a fault current are imparted from the protection relay (100), the shunt trip coil energized and open the circuit breaker (24) ensuring a swift isolation of the fault from the electrical system. The input of the protection relay (100) is linked to a current transformer (26) which is used for transforming current from a higher value to a proportionate lower value which is safely readable by the protection relay (100).

In the installation process of the protection relay (100), the terminal block for the auxiliary power supply (22) is connected to a power supply (which can be either from incoming supply (20) or any other auxiliary power supply). The terminal block for the current transformer (51) is connected into the secondary of the current transformer. The terminal block for the output tripping contact (20) is connected into the shunt trip coil of a circuit breaker.

Numerous modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that, within the scope of the appended

claims, the present invention may be practiced in a manner other than as specifically described herein.

What is claimed is:

1. A digital protection relay (100) equipped with a mechanical trip button (18) comprising:

a signal processing module (10) for converting input energizing quantities from a current transformer into a digital value and a comparator (12) being used for comparing the energizing quantities with a threshold setting value; wherein the mechanical trip button (18) is being latched with an output tripping contact (20) connected to a shunt trip coil (30) of a circuit breaker (24);

a timer (16) linked to a pick-up signal device (14) for inputting a time delay;

a real time clock (84) being linked to event recorder (82) for inputting a time reference; and

an event recorder (82) for storing a tripping event,

thereby the operation of the output tripping contact (20) will energize and cause the circuit breaker (24) to trip and the mechanical trip button (18) to pop out; and
2. The digital protection relay (100) equipped with a mechanical trip button (18) as set forth in Claim 1, wherein the signal from the comparator (12) triggers the output tripping contact (20), pop out the mechanical trip button (18), and the mechanical trip button (18) latched with the output tripping contact.
3. The digital protection relay (100) equipped with a mechanical trip button (18) as set forth in Claim 1, wherein the signal processing module (10) converts input from the current transformer to a corresponded digital value being used for comparing by the comparator (12) containing the threshold setting value to generate a signal to be picked up by the pick-up signal device (14).
4. The digital protection relay (100) equipped with a mechanical trip button (18) as set forth in Claim 1, wherein an event recorder (82) is provided with a function to indicate a test trip or an actual trip.
5. The digital protection relay (100) equipped with a mechanical trip button (18) as set forth in Claim 4, wherein a denoted A is indicated on the event recorder (82) if the trip is an actual fault current trip.
6. The digital protection relay (100) equipped with a mechanical trip button (18) as set forth in Claim 4, wherein a denoted P is indicated on the event recorder (82) if the trip is a test trip.

7. The digital protection relay (100) equipped with a mechanical trip button (18) as set forth in Claim 1, wherein the mechanical trip button (18) is latched with the output tripping contact (20) such that the output tripping contact (20) remains at the position thereof as long as the mechanical trip button (20) is still in pop out position.

5 8. The digital protection relay (100) equipped with a mechanical trip button (18) as set forth in Claim 1, further comprising a LED trip status indicator which is used to indicate the protection relay (100) in an operated state, triggered the shunt trip coil of the circuit breaker (24).

9. The digital protection relay (100) equipped with a mechanical trip button (18) as set
10 forth in Claim 8, wherein the LED trip status indicator is lighted when the mechanical trip button (18) is popped out and remains lighted thereof as long as the mechanical trip button (18) is still in pop out position.

10. The digital protection relay (100) equipped with a mechanical trip button (18) as set forth in Claim 9, wherein an auxiliary power supply is provided to the LED trip status indicator.