

Bypass Device For Directly-Connected kWh Meters

Field of the Invention

This invention relates to a device and a method of using the device to electrically
5 bypass a meter-board for directly-connected kWh (electrical) meters, allowing a competent technician to safely replace the meter without supply interruption to the customer.

Prior Art

The direct meter replacement cycle is about 15 years. As direct meters are
10 connected in-situ of the circuit, replacing them requires an electrical shutdown. Utilities companies or metering service providers around the world face this issue of supply disruption when replacing a meter. There are currently different variants of meter bypass tools, used mainly with American meter board variants to allow easy bypass of the meter during meter maintenance. However, all researchable variants still involve a supply
15 disruption to install the bypass device.

Horn bypass is one of the known bypass tools. Horn bypass jumpers are jumper cables used solely for American meter housing with specially designed "horns" at the terminals to allow the jumper wires to clip-on them. This minimises electricity supply disruption. However, a special "horn" socket needs to be installed on the meter board
20 bushings first, requiring some modifications to be made on a "dead" meter board. This involves extended periods of supply disruption.

Lever bypass is another known bypass tool. Lever bypass jumpers are used for American meter sockets with specially designed lever-operated switches to allow the user to bypass the meter-board. This minimises electricity supply disruption. However, the entire
25 meter board needs to be replaced, requiring extended periods of supply interruption.

As described above, the bypass tools during meter maintenance involve a disruption during meter replacement. Therefore, those skilled in the art are striving to

provide an improved bypass tool to avoid disruption of power supply to customer when replacing or performing maintenance of the meter board.

Summary of the Invention

5 The above and other problems are solved and an advance in the art is made by a bypass device in accordance with this invention. A first advantage of the bypass device in accordance with this invention is that the bypass device allows replacement of direct meters without power supply interruption to the customer. A second advantage of the bypass device in accordance with this invention is that the bypass device can be implemented on
10 any meter-boards, so long as a useable "live" conductor on both the incoming and outgoing circuitry are exposed and accessible for the magnetic contacts to connect to. A third advantage of the bypass device in accordance with this invention is that the bypass device does not involve replacement of existing meter-boards. In summary, the impact of supply disruption to our customers is completely negated, and there is no need to replace the
15 meter-board itself. This device therefore allows utilities and metering service providers worldwide to implement replacement programmes for electrical meters without the worry of managing negative customer impact (due to undesirable electrical shutdowns) and avoid additional infrastructure costs (no need to replace the meter-boards itself).

A first aspect of the disclosure describes a bypass device for replacing a direct
20 meter without supply interruption to a customer load. The bypass device comprises: a first and a second miniature circuit breaker (MCB) switches; a first pair of permanent magnetic contacts provided on each of an in port the first and second MCB switches and adapted to be connected to an in port and an out port of the incoming supply of the meter; a second pair of permanent magnetic contacts provided on each of an out port of the first and second
25 MCB switch and adapted to be connected to an in port and an out port of the customer load; a first indicator connected to the in port of the first MCB switch and the out port of the second MCB switch, a second indicator connected to the in port of the first MCB switch and

the in port of the second MCB switch and adapted to be connected to the in port and the out port of the incoming supply of the meter, and a third indicator connected to the out port of the first MCB switch and the out port of the second MCB switch and adapted to be connected to the in port and the out port of the customer load.

5 In accordance with an embodiment of the first aspect of the disclosure, the bypass device further comprises a pair of relays connectable to each other via the first and second MCB switches.

 In accordance with an embodiment of the first aspect of the disclosure, each of the first, second and third indicators comprises one of light bulbs and voltmeter.

10 In accordance with an embodiment of the first aspect of the disclosure, the bypass device further comprises a movable mount with securing means for securing the first and the second MCB switches, the first and second pairs of permanent magnetic contacts and the first, second and third indicators to the movable mount.

 In accordance with an embodiment of the first aspect of the disclosure, each of the
15 first and second pairs of permanent magnetic contacts comprises a permanent magnetic rod. In accordance with an embodiment of this embodiment, each of the first and second pairs of permanent magnetic contacts further comprises an electrical connector having a housing and a fastener electrically connected to the first and second MCB switches and one end of the permanent magnetic rod.

20 In accordance with an embodiment of the first aspect of the disclosure each of the first and second pairs of permanent magnetic is neodymium magnet made of an alloy of neodymium, iron and boron. In accordance with an embodiment of this embodiment, each of the first and second pairs of permanent magnetic is coated with nickel.

 A second aspect of the disclosure describes a method of replacing a direct meter
25 using the bypass device described in the first aspect of the disclosure without supply interruption to a customer load. The method comprising: connecting the first pair of permanent magnetic contacts to an incoming exposed screw and an outgoing exposed

screw of a first MCB of the direct meter; connecting a second pair of permanent magnetic contacts to an incoming exposed screw and an outgoing exposed screw of a second MCB of the direct meter; checking the first, second and third indicators of the meter bypass device; in response to the first, second and third indicators lighting up, switching on the first
5 and second MCB switches of the bypass device; switching off the first and second MCBs of the direct meter and replacing the meter with a new direct meter.

In accordance with an embodiment of the second aspect of the disclosure, the method further comprising: upon completion of the replacement of the new meter, switching on the first and second MCBs of the new direct meter; switching off the two MCB switches
10 of the bypass device; and disconnecting the first and second pairs of permanent magnetic contacts from the first and second MCBs of the new direct meter.

Brief Description of the Drawings

The above and other features and advantages in accordance with this invention are
15 described in the following detailed description and are shown in the following drawings:

Figure 1 illustrating an electrical schematic of a bypass device in accordance with an embodiment of this invention;

Figure 2 illustrating another electrical schematic of a prototype of the bypass device in accordance with an embodiment of this invention;

20 Figure 3 illustrating a picture of an implementation of the prototype of the bypass device as shown in figure 2 in accordance with an embodiment of this invention;

Figure 4 illustrating a process flow on the use of the bypass device in accordance with an embodiment of this invention;

Figure 5 illustrating a picture of a single phase wattmeter;

25 Figure 6 illustrating a picture of the single phase wattmeter with the MCB/Isolator cover removed;

Figure 7 illustrating a picture of the bypass device connected to the MCB/Isolator of the single phase wattmeter;

Figure 8 illustrating a picture of the bypass device as shown in figure 1 being connected to the MCB/Isolator of a single phase wattmeter in accordance with an
5 embodiment of this invention; and

Figure 9 illustrating a neodymium contact in accordance with an embodiment of this invention.

Detailed Description

10 This invention relates to a device and a method of using the device to electrically bypass a meter-board for directly-connected kWh meters, allowing a technician to safely replace the meter without supply interruption to the customer.

The bypass device in accordance with an embodiment of this invention enables a user to avoid supply interruption to the customer when attempting to replace a directly-
15 connected meter. The bypass device utilises neodymium contacts to physically connect to live conductors (any "live" ferrous conductors) in a safe and easy manner. Once contact with the live parts is made, visual indicators will indicate whether the connections are in order. The bypass device is thereafter enabled, and the kWh meter can be replaced with no electricity supply disruption to the circuit downstream.

20 Figure 1 illustrates an electrical schematic of a bypass device (100) in accordance with an embodiment of this invention. The bypass device (100) comprises a pair of bypass Miniature Circuit Breaker (MCB) switches (300), a first pair of neodymium contacts (220, 230) provided on an in port of the first MCB switch 301 and an in port of the second MCB switch 302 and adapted to be connected to the in port and out port of the incoming supply
25 (250), a second pair of neodymium contacts (220, 230) provided on an out port of the first MCB switch 301 and an out port of the second MCB switch 302 and adapted to be connected to the in port and out port of the customer load (260), a first indicator (310)

connected to the in port of the first MCB switch (301) and the out port of the second MCB switch (302) and adapted to be connected to the in port of the incoming supply (250) and the out port of the customer load (260), a second indicator (320) connected to the in port of the first MCB switch and the in port of the second MCB switch (302) and adapted to be
5 connected to the in port and an out port of the incoming supply (250), and a third indicator (330) connected to the out port of the first MCB switch (301) and the out port of the second MCB switch (302) and adapted to be connected to the in port and an out port of the customer load (260). The first, second and third indicators may be light bulbs and/or a voltmeter. Figure 3 shows a picture of an implementation of the bypass device as shown in
10 figure 1 in accordance with an embodiment of this invention. Further details on the neodymium contacts will be described below with reference to figure 9.

Figure 2 illustrates an electrical schematic of an alternative bypass device (100') in accordance with an embodiment of this invention. The alternative bypass device (100') is a modification of the bypass device 100 where additional relays are provided. Specifically,
15 a pair of relays (211, 212) is provided and connectable to each other via the two MCB switches (300) to form the meter bypass device (100'). The first pair of neodymium contacts are provided on an in port and an out port of the first relay (211) and adapted to be connectable to the incoming supply (250), and a second pair of neodymium contacts provided on an in port and an out port of the second relay (212) and adapted to be
20 connectable to the customer load (260). For brevity, the three indicators are omitted from figure 2. The three indicators in the form of light bulbs and/or voltmeters are necessary in order to indicate to the technician on whether the connections are correctly connected. Further details on the neodymium contacts will be described below with reference to figure 9.

25 As shown in figures 1 and 2, a typical meter-board (500) comprises a direct meter (510) electrically connected between 2 MCBs (410 and 420). Conventional method of replacing the direct meter (510) would require triggering off the 2 MCBs (410 and 420). This

means that customer would not have any electrical supply during replacement. The bypass device (100) or alternative bypass device (100') allows electrical supply from the incoming supply (250) from the grid to be directly connected to the customer load (260), bypassing the meter (510). This allows a technician to replace an old meter (510) without causing
5 interruption on the electrical supply to the customer.

Figure 4 illustrates a process flow 700 on the use of the alternative bypass device (100') in accordance with an embodiment of this invention. Process 700 begins with step 705 by connecting the first pair of neodymium contacts provided on the in port and an out port (220, 230) of the first relay (211) of the alternative bypass device (100') to an incoming
10 exposed screw (411) and an outgoing exposed screw (412) of a first MCB (410) of the meter-board (500). As mentioned above in relation to figure 2, the first relay (211) of the alternative bypass device (100') is connected to the in port of the two MCB switches (300).

In step 710, process 700 connects a second pair of neodymium contacts provided on an in port and an out port (220, 230) of the second relay (212) of the alternative bypass
15 device (100') to an incoming exposed screw (421) and an outgoing exposed screw (422) of a second MCB (420) of the meter-board (500). As mentioned above in relation to figure 2, the second relay (212) of the alternative bypass device (100') is connected to the out port of the two MCB switches (300). In the bypass device (100), since relays are omitted, the first pair of neodymium contacts would be provided on the in port the first MCB (301)
20 and the in port of the second MCB switch 302 and the second pair of neodymium contacts would be provided on the out port of the first MCB switch (301) and the out port of the second MCB switch (302).

In step 715, process 700 checks an indicator of the meter bypass device (100) or alternative bypass device (100') to ensure that the connection with the conductors are good.
25 Specifically, the technician would check the readings on the three voltmeters (310, 320, 330) and if indicators are used, check that the indicators are turned on. If the readings on

the three voltmeters are correct, showing approximately 230V, and the indications provided are correct, process 700 proceeds to step 720.

In step 720, process 700 switches on the two MCB switches (300) connected between the first and second relays. Specifically, the technician would trigger the switches
5 of the two MCB switches (300) to on. This would cause live parallel connection between the bypass device (100) or alternative bypass device (100') and the meter (510). In one embodiment, a light bulb may be provided for each of the first and second MCB switches (301 and 302) in series connection such that when the two MCB switches (300) are switched on, the light bulb would light up to indicate power supply is routed from the
10 incoming supply (250) to the customer load (260).

In step 725, process 700 switches off the first and second MCBs (410, 420) of the meter-board (500). Specifically, the technician would trigger the switches of first and second MCBs (410, 420) to off. This would cause electrical supply to be cut off between the direct meter 510 but routed to the customer load 260 via the bypass device (100) or
15 alternative bypass device (100').

In step 730, process 700 replaces the meter (510). Specifically, the technician would remove the old meter and replace it with a new meter. After completion of the replacement of a new meter, process 700 proceeds to step 735.

In step 735, process 700 switches on the first and second MCBs (410, 420) of the
20 new meter (510). This would cause live parallel connection between the bypass device (100) or alternative bypass device (100') and the new direct meter (510).

In step 740, process 700 switches off the two MCB switches (300). This would cause electrical supply to be routed to the customer load (260) via the new direct meter (510) only.

25 In step 745, process 700 disconnect the first and second pairs of neodymium contacts and remove the bypass device from the new direct meter (510). Process 700 ends after step 745.

Figure 5 shows a picture of a common meter box. As shown in figure 5, the meter box comprises a single-phase wattmeter (510) and a MCB/isolator (530) covered by a removable cover (520). Figure 6 shows a picture of the MCB/isolator (530) without the removable cover (520). Figure 7 shows a picture of the bypass device (100) connected to the MCB/isolator (530). As shown in figure 7, the prototype cables are too short. As some meter boards may have MCB and isolators that are inconveniently located, this may lead to problems using the bypass device (100). Further, there may be potential risk of Live to Neutral fault if connections are transposed. Hence, in order to prevent Live to Neutral fault, the alternative bypass device (100') includes 2 relays to negate the Live to Neutral fault.

Figure 8 shows a picture of the alternative bypass device (100') being installed to the meter box. As shown in figure 8, the alternative bypass device (100') has additional indicator switches for ensuring good connection and longer cables to allow connectors to reach out to the meter board. The alternative bypass device (100') may be mounted to a movable mount to improve handling and ergonomics. The movable mount has securing means for securing the first and a second MCB switches, the relays, the first and second pairs of neodymium contacts and the first, second and third indicators to the movable mount

The neodymium contacts in the bypass device (100) and alternative bypass device (100') are magnetically-electrically active neodymium magnetic contacts to be connected to the live circuit before and after the meter-board. Specifically, the bypass device (100) and alternative bypass device (100') takes advantage of ferrous screws on the meter board's incoming MCB/Isolators (410) and outgoing MCB/Isolators (420), and magnetically-electrically active neodymium contact of the bypass device 100 and alternative bypass device 100' to bypass electrical supply to the meter-board, thereby maintaining stable electricity supply to the customer without major modifications to the meter-board. Thereafter, the supply to the meter (500) can be isolated, and the meter (500) replaced without interrupting supply to the customer. Figure 9 illustrates a neodymium contact (900). A neodymium contact (900) is essentially a neodymium rod (930) for magnetically

connecting the exposed screws of the incoming MCB/Isolators (410) and outgoing MCB/Isolators (420) to respective MCBs of the bypass device (100) or alternative bypass device (100'). As shown in figure 9, the neodymium rod (930) is securely connected to an electrical connector (910). The electrical connector (910) comprising a housing (911) and
5 a screw (912). One end of the wiring (920) is connected to the MCB switches (301) and (302) while the other end is securely connected to the screw (912) when the screw (912) is tightened downward as shown in the arrow. Due to the magnetic property of the neodymium rod (930), it can be easily connected to the exposed screws of the incoming MCB/Isolators (410) and outgoing MCB/Isolators (420). These magnetically-electrically active neodymium
10 magnetic contacts have never been utilised for this purpose. The neodymium rod (930) may be spring-loaded connectors (which is similar to a ballpoint pen) to hold magnetic connectors firmly in place. The connectors (910) may be CP5 approved connectors with CP5 colouring scheme for the cables.

The direct use of neodymium magnets coated with nickel plating as conductive
15 magnetic contact is one of the features of the bypass device (100) and alternative bypass device (100'). Neodymium magnets are rare-earth permanent magnets made from an alloy of neodymium, iron and boron. The three primary enabling characteristics are as follows:

1. Very high electric and magnetic coercivity (resistance to being demagnetized – using an external electric or magnetic field respectively)
- 20 2. High Curie temperature (the temperature above which its magnetic strength disappears)
3. Nickel-coated Neodymium magnets are also excellent conductors of electricity.

A combination of these characteristics enables the magnets to easily and safely connect with the exposed incoming and outgoing MCBs "live" and ferrous conductors. This
25 magnetically-electrically active feature allows the user to avoid supply interruption to the customer by shunting the meter-board, effectively bypassing it without the hassle of adjusting the existing installation. For purposes of this disclosure, the term "neodymium

contacts” are essentially made of permanent magnets such as neodymium magnets. Further, to improve electrical conductivity, a coat of nickel can be added to the permanent magnet as conductive magnetic contact. Hence, the term “neodymium contacts” can also be used interchangeably as “permanent magnetic contacts” or “contacts, where the
5 contacts are permanent magnet” and “neodymium rod (930)” can be used interchangeably as “permanent magnetic rod (930)”. One skilled in the art will recognize that other than a nickel coat, other conductive magnetic material can be used without departing from the invention.

The bypass device (100) and alternative bypass device (100') have indicators, in
10 the form of voltmeters and light, providing feedback to the user on the electrical connection's continuity and stability in a safe manner to the users. The indicators will be lit and not flickering if the connections are strong. The indicators can also prevent the user from accidentally transposing L-N, causing a live-to-neutral short.

The alternative bypass device (100') also has two build-in solid state relays (211,
15 212) that disconnects supply when a wrong contact is made (transposed connection), thereby automatically preventing a live-to-neutral short.

One skilled in the art will recognize that instead of two MCB switches in the bypass device (100) and alternative bypass device (100'), other circuit break switches such as Residual Circuit Current Breaker (RCCB), may be implemented without departing from the
20 invention.

The above is a description of exemplary embodiments of a bypass device for replacement of a direct meter in a meter-board in accordance with this disclosure. It is foreseeable that those skilled in the art can and will design alternative devices or apparatuses based on this disclosure.

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