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Implementation of Three Phase Earth Leakage Circuit Breaker

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ABSTRACT:-
An ECLB is one kind of safety device used for installing an electrical device with high earth impedance to avoid shock. These devices identify small stray voltages of the electrical device on the metal enclosures and intrude the circuit if a dangerous voltage is identified. The main purpose of Earth leakage circuit breaker (ECLB) is to stop damage to humans & animals due to electric shock. An ELCB is a specific type of latching relay that has a structure's incoming mains power associated through its switching contacts so that the circuit breaker detaches the power in an unsafe condition.The ELCB notices fault currents of human or animal to the earth wire in the connection it guards. If ample voltage seems across the ELCB's sense coil, it will turn off the power, and remain off until manually rearrange. A voltage sensing ELCB doesn't detect fault currents from human or animal to the earth.

Keywords- Earth leakage circuit breaker, Residual circuit breaker.

I. INTRODUCTION

In any electrical system, protection is the most important requirement to secure both human lives and application from the damage. The THREE PHASE EARTH LEAKAGE CIRCUIT BREAKER (ELCB) is a design which could be implemented in three phase electrical environment to provide protection to user as well as equipment's against any earth leakage fault. In three phase circuit all current carrying conductors must be sensed.

An Earth-leakage circuit breaker (ELCB) is a safety device used in electrical installations with high Earth impedance to prevent shock. It detects small stray voltages on the metal enclosures of electrical equipment, and interrupts the circuit if a dangerous voltage is detected. Once widely used, more recent installations instead use residual current circuit breakers which instead detect leakage current directly.

II. EARTH LEAKAGE CIRCUIT BREAKER

This is a category of devices, which are used to protect instruments, circuits and operators, while Earth leakare voltage operated devices (VO-ELCB), detecting a voltage rise between installation metalwork, and an external electrode. These have now been replaced by current sensing devices (RCD/RCCB). In modern literature voltage sensing devices are called ELCB or VOELCB and current sensing devices are called RCCB or RCD.

Voltage sensing ELCBs were first introduced about sixty years ago. Current sensing ELCBs were first introduced about forty years ago. For many years, the voltage operated ELCB and the differential current operated ELCB were both referred to as ELCBs because it was a simpler name to remember. But the use of a common name for two different devices gave rise to considerable confusion in the electrical industry. If any current leaks from any electrical installation, there must-be any insulation failure in the electrical circuit , it must be properly detected and prevented otherwise there may be a high chance of electrical shock if-anyone touches the installation. An earth leakage circuit breaker does it efficiently. Means it detects the earth leakage current and makes the power supply off by opening the associated circuit breaker . There are two types of earth leakage circuit breaker:

1. Voltage ELCB
2. Current ELCB

Voltage Earth Leakage Circuit Breaker

The working principle of voltage ELCB is quite simple. One terminal of the relay coil is connected to the metal body of the equipment to be protected against earth leakage and other terminal is connected to the earth directly.If any insulation failure occurs or live phase wire touches the metal body, of the equipment, there must be a voltage difference appears across the terminal of the coil connected to the equipment body and earth. This voltage difference produces a current to flow the relay coil

Current Earth Leakage Circuit Breaker

Three Phase Residual Current Circuit Breaker or Current ELCB. When this difference crosses a predetermined value, the current in the third secondary winding of the core becomes sufficiently high to actuate the electromagnetic relay attached to it. This relay causes tripping of the associated circuit breaker to disconnect the power supply to the equipment under protection. Residual current circuit breaker is sometimes also referred as residual current device (RCD) when we consider the device by disassociating the circuit breaker attached to RCCB . That means, the entire parts of RCCB except circuit breaker are referred as RCD.

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III. OPERATION OF ELCB TRIP SITUATION

Two kinds of fault are usually identified by ELCB that include temporary fault and permanent fault:

1 PERMANENT FAILURE:

Normally, it trip when there is any leakage current from circuit to ground or earth. For permanent failure, the damage should be repaired foremost or get rid of it from the current before automatically trigger back ELCB. If the damage not to repair or eradicate the damage from circuit, If not so, it will trip once more once the ELCB turn out to be automatically triggered. If this occurs numerous times, it will destroy the ELCB. An example is electrical, electronic appliance or short circuit

2. TEMPORARY FAILURE

This is able to have the ELCB triggered devoid of having repair initially or do away with the supply circuit damage. In case of the occurrence of overloading and lighting in industrial or residential premises, it can generate additional problems to the user by automatically triggering itself. Lighting is one perfect illustration of this problem.

IV. BLOCK DIAGRAM OF ELCB.

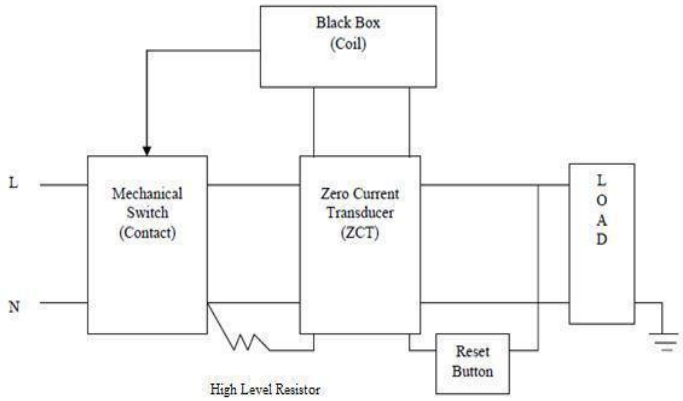

Fig.1 Block diagram of Earth Leakage Circuit Breaker

The design comprises Mechanical Switch, Black Box, ZCT, Rest Button and High Level Resistor. Mechanical switch is a contact of black box and the purpose of this component is to activate and stop the power by cutting off the neutral and life line in general. The purpose of high level resistor or test resistor is to experiment whether ELCB is operational or not by offering a short circuit within internal ELCB neutral and life. By offering a new current course throughout test condition, current flow through life wire is separated. The current within the neutral is below the current within the life wire once the reset button is pressed. The reset button's function is to re-set back the instrument to the original condition and as well as a spot to identify whether the instrument is still within good state or damage/expired. The black box's function is to induce a magnetic field and subsequently de-energize the magnetic coil within the black box .

From figure.3, the ELCB design schematic has been exemplified. The ZCT is responsible for detecting the unbalance current from neutral or live or grounded live polarities. The ELCB tripping ability depends on the ZCT sensitivity. A residential household will require a 0.1 A ECLB being in use, meaning that any unbalance current equal or more than 100 mA will make ZCT to induce current while de-energizing the black box's magnetic coil, and eventually disconnecting the mechanical switch

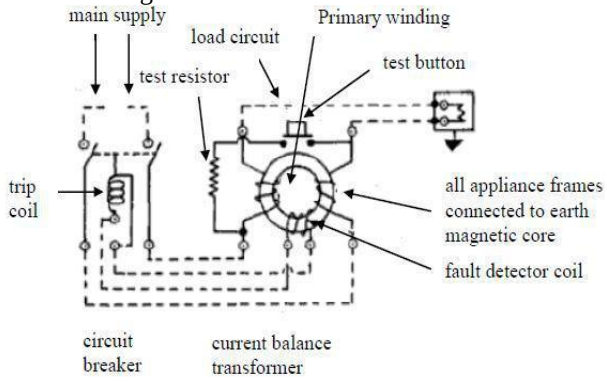

Fig 2. Earth Leakage Circuit Breaker Design Schematic

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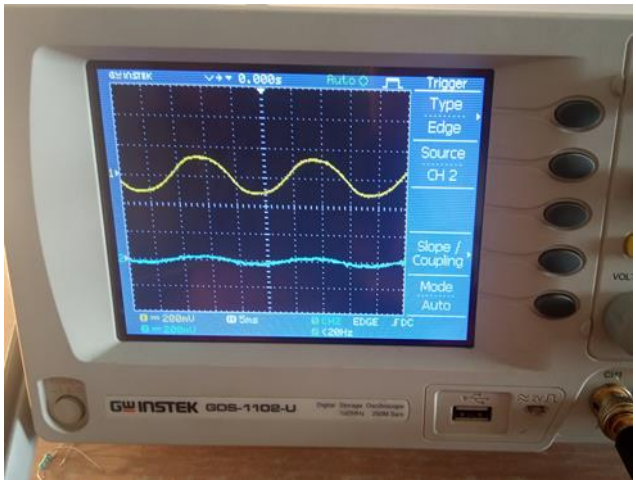
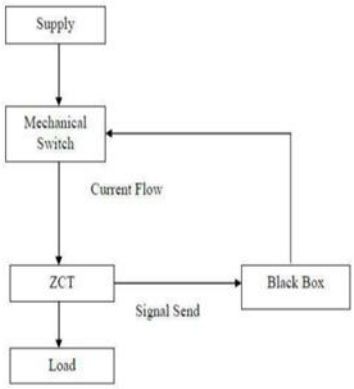


V. OPERATION OF ELCB

Fig 3. Operation of ELCB

With reference to fig. 4,in case of any faults, the detection of current L and N imbalance value is achieved using CT, thereby the induced current occurring in CT, induced current attaining the least value to activate the coil is sent to the trip coil as a signal, and upon activate of the coil it senses the trigger contact which triggers the mechanical switch automatically thereby disconnecting the supply from the mainline.



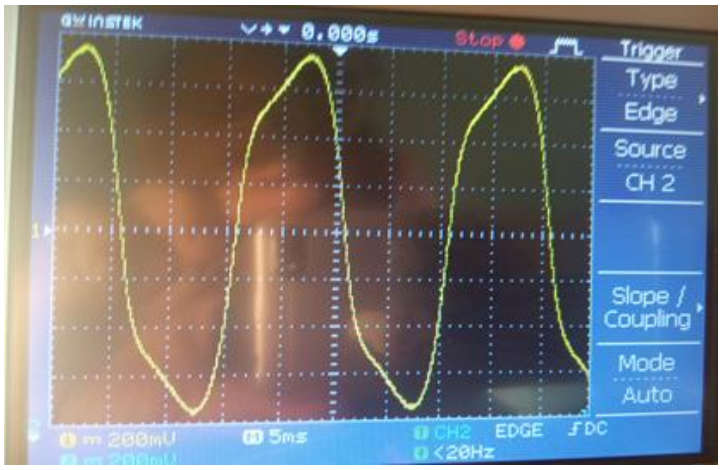


Fig4. Operation of ELCB

VI. RESULT

When input is equal to output, then there are no fault detection, Hence we found following results.

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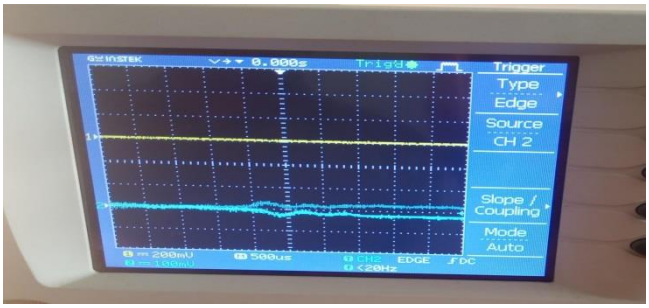

And when input is not equal to output and there are any leakage present then we are found that this following result.

VII. CONCLUSION

In this paper, detecting earth leakage in a three phase system by a current transformer is discussed. The procedure consists of building the schematic design. The most hazardous fault is considered to be an electric shock but it was noticed that in a conventional ELCB speed of detecting fault was too slow and also the currents difference by which it detected fault was too high.

VIII. REFERENCE

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