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On Load Tap Changer Transformer in Automatic Controlling System

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Abstract: *The demand for stable and reliable electrical power is increasing with the growth of industries and modern infrastructure. Voltage regulation plays a critical role in ensuring the quality and stability of power supplied to consumers. This project presents the design and implementation of an On Load Tap Changer (OLTC) in an Automatic Controlling System, aimed at maintaining voltage levels within the permissible range under varying load conditions.*

The OLTC mechanism allows for real-time voltage adjustment in power transformers without interrupting the power supply. In this system, a microcontroller-based control unit continuously monitors the output voltage of the transformer. When the voltage deviates from the preset range, the controller automatically operates the tap changer to adjust the transformer winding tap position, thereby regulating the output voltage. Sensors, relays, and motor drivers are integrated to ensure precise and safe operation of the tap changer.

The automation of tap changing enhances system reliability, reduces manual intervention, and improves power quality. The project demonstrates how intelligent control systems can be used in electrical grids to optimize performance and ensure continuous and efficient power delivery.

Keywords: Reliable Electrical power, OLTC, Voltage, Automation, grids, Optimize, Efficient etc.

I. INTRODUCTION

Definition of OLTC

An On Load Tap Changer (OLTC) is a specialized mechanical device attached to a power transformer that allows the voltage ratio to be adjusted while the transformer is still energized and under load. It achieves this by changing the connection point (tap) on the transformer winding without disrupting the power supply. Unlike Off-Load Tap Changers (which require the transformer to be de-energized), OLTCs enable seamless voltage regulation in real time. This functionality is critical in modern power systems, where uninterrupted service and voltage stability are top priorities.

Basic Purpose and Importance

The core purpose of an OLTC is to regulate the output voltage of a transformer in response to fluctuations in input voltage or varying load conditions. In power transmission and distribution networks, voltage drops or surges are common due to load changes throughout the day. OLTCs automatically adjust the tap position to maintain the desired output voltage within acceptable limits.

The importance of OLTCs lies in their ability to:

- Enhance voltage stability across the grid.
- Improve power quality delivered to end-users.
- Prevent equipment damage caused by overvoltage or undervoltage conditions.
- Eliminate the need for manual intervention or shutdown for voltage adjustment.

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II. LITERATURE REVIEW

OLTC transformers are relatively common devices in sub-transmission and distribution systems. This fact is demonstrated by the constant interest in the improvement of OLTC technology, modelling, and regulation, as well as by several studies on power flow and stability analysis. Relevant literature on each topic is given below.

2.1 OLTC Technology

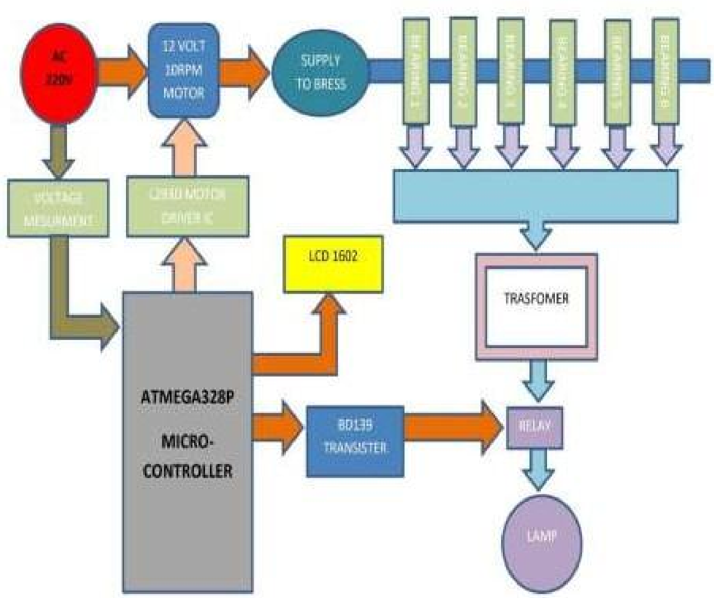
The oldest and most common technology for changing the tap ratio is based on motors that physically move the brushes over the turns of the coil. This is called the mechanically assisted ULTC. Such motor-based ULTCs are characterized by a slow time response (tens of seconds). A dead band in the voltage control is needed to avoid unnecessary movements of the brushes. More recently, two novel technologies have been object of intensive study and development, namely electronically assisted and solid-state ULTCs. [3] This paper proposes a hybrid control model of under load tap changer transformers. The proposed model is based on the well-known discrete and continuous control models of such device, and is designed so that it preserves the discrete behavior of the tap ratio. The case studies show that the proposed model is robust, precise and has a computational burden comparable with the continuous model.

2.2 Distribution Transformer with OLTC

Until recently, the application of OLTC was conventially limited to HV/HV or HV/MV transformers, while the small, low-cost distribution transformers did not warrant the expense and complexity of OLTC and were thus normally provided with off-circuit taps. This arrangement enabled the tap positions to be adjusted to suit the network conditions, usually when the transformer was initially placed into service. However, the facility enabled adjustments to be made subsequently, when possible changes to the network loading have necessitated this. [1] The paper describes technical benefits of distribution transformers.

On-load tap-changer (OLTC) implemented in a Flemish LV distribution grid. From the assessment, it was concluded that the OLTC partly eliminates the violations of both voltage statutory limits and thermal constraints, however, voltage unbalances can increase due to the independent tap-changing control per phase.

Block Diagram



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III. FEATURES

- 500 mA rated collector current (single output)
- 50 V output
- Includes output fly back diodes
- Inputs compatible with various types of logic

IV. RESULTS

- Higher efficiency 99%
- Continuous voltage regulation
- Improved power quality
- Reduce power loss
- Longer lifespan equipment
- Industrial Use
- Allows changes in voltage ratio without de-energizing the transformer

V. APPLICATIONS

- Power distribution transformer
- Transmission substations
- Industrial power system
- Power Quality Improvement
- Power Loss Minimization

VI. FUTUER SCOPE

In advancement of insulating medium vacuum is good insulating material as a replacement of oil which can increase the number of operations, life and reduced maintenance of OLTC. At present, as well as in the foreseeable future, the proper implementation of vacuum switching technology in OLTCs provides the best formula for quality, reliability and economy that can be achieved for maintenance-free design in the field of OLTCs. Vacuum switching technology entirely eliminates the need for an on-line filtration system and offers reduced downtimes with increased availability of the transformer and simplified maintenance logistics.

VII. CONCLUSION

Thus, we have concluded that OLTC by using OLTC In Automatic Controlling System is performing its work satisfactorily. It maintains the load side voltage of transformer without any interruption. It has more controllable operation during tap changing process which helps to reduce the arcing phenomena. OLTC is able to correct several disturbances of the ac mains automatically.

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