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EFFICIENT AND RELIABLE OPERATION LOAD SHARING OF ISOLATING AND TAP CHANGING TRANSFORMER

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ABSTRACT

In this paper, in load sharing applications, multiple tap changing transformers can be connected in parallel and their taps can be adjusted to share the load. Overall, load sharing using isolation transformers and tap changing transformers is a reliable and efficient way to ensure that power is distributed evenly across a network, while also ensuring that sensitive equipment receives a clean power supply.

INTRODUCTION

Load sharing is an important aspect of power distribution systems that involves dividing the total load among multiple transformers to ensure efficient and reliable operation. Isolation transformers and tap changing transformers are two types of transformers commonly used in load sharing applications.

An isolation transformer is designed to provide electrical isolation between the input and output, which makes it ideal for use in sensitive equipment that requires a clean power supply. In load sharing applications, multiple isolation transformers can be connected in parallel to share the load.

A tap changing transformer, on the other hand, allows the transformer ratio to be adjusted by changing the position of the tap on the winding. This allows the transformer to be used in applications where the load may vary, such as in distribution systems where the load is spread across different regions. Transformers are the electrical devices that are used to transfer the electrical energy from one circuit to another, typically by using electromagnetic induction. They are used in a wide variety

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of applications, from power distribution and transmission to electronic devices such as televisions and computer power supplies.

The basic principle of transformer is the transfer of energy between two coils that are linked by a magnetic field. The input coil, or primary winding, is connected to a source of alternating current (AC) voltage. This alternating current produces a magnetic field that is coupled with the secondary winding, or output coil, causing an induced voltage to be generated in the secondary winding.

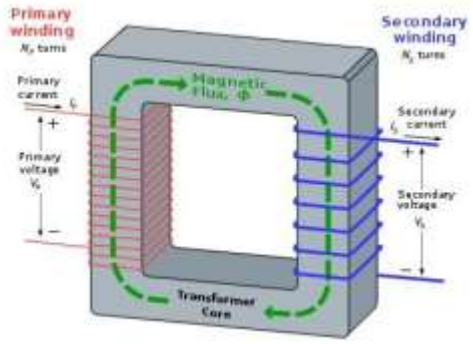

Fig: Constructional Diagram of Transformer

PROPOSED SYSTEM

Load sharing of isolation and single-phase transformers refers to the process of sharing the load between two or more transformers to ensure efficient and reliable operation. This is particularly important in applications where the load demand fluctuates, and the available capacity of a single transformer may not be sufficient to meet the demand.

The load sharing process can be accomplished through various methods, including tap changing transformers, voltage regulators, load shedding, or parallel operation. Tap changing transformers have multiple taps on their primary winding, which can be used to adjust the transformer's voltage output to compensate for changes in load.

To implement load sharing, the primary sides of both the isolating transformer and the tap-changing transformer are connected in parallel to the same supply voltage. The secondary sides of the transformers are then connected in parallel to the load. This allows both transformers to share the load and distribute the electrical power.

The tap positions of the tap-changing transformer can be adjusted to regulate its output voltage and ensure equal load sharing. Tap positions are typically changed manually or automatically based on the load measurements. If one transformer is carrying a higher load, the tap position can be increased to decrease its output voltage and share the load with the other transformer. Conversely, if one transformer is carrying a lower load, the tap

position can be decreased to increase its output voltage and balance the load between the transformers.

ADVANTAGES OF PROPOSED SYSTEM:

Load sharing of isolation and single-phase transformers has several advantages, including:

1. **Improved efficiency:** Load sharing allows for the efficient utilization of available capacity by evenly distributing the load among the transformers, which can help to reduce energy waste and lower operating costs.
2. **Increased reliability:** Load sharing improves the overall reliability of the system by providing redundancy in case of transformer failure. In parallel operation, if one transformer fails, the other transformers can continue to supply power to the load.
3. **Better voltage regulation:** Load sharing can help to maintain the desired voltage level by adjusting the voltage output of each transformer to match the load demand.
4. **Longer transformer lifespan:** Load sharing can help to reduce the stress on individual transformers by evenly distributing the load, which can help to extend the lifespan of the transformers and reduce maintenance costs.
5. **Improved Safety:** Isolation transformers provide galvanic isolation between the input and output circuits, which can enhance safety by isolating the load from the input power supply. This can help protect sensitive electronic devices and equipment from potential hazards such as electrical shocks, ground faults, and transient voltages. Tap-changing transformers, on the other hand, allow for convenient adjustment of output voltages to match specific load requirements, which can help optimize the system's performance and prevent overloading or underloading of transformers.
6. **Enhanced Power Quality:** Isolation transformers can mitigate issues related to common mode and differential mode noise, harmonic distortion, and voltage spikes, which can help improve power quality. Tap-changing transformers can also help maintain stable output voltages, reducing voltage fluctuations and ensuring consistent

power supply to the load. Improved power quality can result in better performance of sensitive equipment, reduced downtime, and increased reliability of the load sharing system.

7. **Efficient Load Sharing:** Tap-changing transformers can help achieve better load sharing among the transformers connected in parallel. By adjusting the tap settings based on the load demand, the load can be evenly distributed among the transformers, which can prevent overloading of one or more transformers and ensure efficient utilization of the entire transformer bank. This can result in increased system efficiency, reduced losses, and extended lifespan of the transformers.
8. **Flexibility and Adaptability:** Tap-changing transformers provide flexibility in adjusting the output voltage levels to match changing load requirements. This can be particularly beneficial in applications where the load demand varies over time, allowing for easy adaptation to different load conditions without the need for additional transformers or complex rewiring. This can offer increased operational flexibility, scalability, and cost-effectiveness in managing varying load conditions.
9. **Advanced Monitoring and Control:** Tap-changing transformers can be equipped with advanced monitoring and control features, such as microprocessor-based relays, digital communication, and automation, which can enable remote monitoring, diagnostics, and control of the transformer bank. This can help improve system reliability, reduce downtime, and enable proactive maintenance and troubleshooting.
10. **Enhanced Protection**: Isolation transformers and tap-changing transformers can offer enhanced protection features, such as overcurrent protection, fault detection, and selective tripping. Advanced protection schemes can help detect and isolate faults quickly, preventing damage to the transformers and ensuring safe and reliable operation of the load sharing system.

11. **Energy Savings:** Efficient load sharing and improved power quality offered by isolation transformers and tap-changing transformers can result in reduced energy losses and lower energy consumption. This can contribute to energy savings, cost savings, and reduced environmental impact.

OBJECTIVE OF PROJECT

The objective of load sharing of isolation and tap changing transformers is to distribute the load among multiple transformers in a way that ensures reliable and efficient operation of the system. Some of the key objectives of load sharing include:

1. Improved reliability: By using multiple transformers in parallel, the system becomes less vulnerable to failure in the event of a single transformer failure. This provides a higher degree of redundancy and improves the reliability of the system.
2. Increased capacity: By sharing the load among multiple transformers, the overall capacity of the system is increased. This can be especially useful in applications where the load is highly variable or where there are periods of high demand.
3. Improved efficiency: By distributing the load among multiple transformers, each transformer operates at a lower load level, which can improve its efficiency and reduce losses. This can lead to significant energy savings over time.
4. Better regulation: By using multiple transformers with different taps, it is possible to achieve better regulation of the output voltage. This can be especially important in applications where a stable voltage is required, such as in sensitive electronic equipment.
5. Flexibility: By using multiple transformers, it is possible to adjust the output voltage and capacity of the system to meet changing demands. This provides a higher degree of flexibility in the operation of the system.

LITERATURE SURVEY

One recommended resource is the book "Transformer Engineering: Design, Technology, and Diagnostics" by S.V. Kulkarni. This book provides an in-depth analysis of the various aspects of transformer design and operation, including load sharing in single-phase transformers and isolation transformers. It covers the

theoretical background, practical implementation, and case studies related to load sharing in transformers.

Another useful resource is the IEEE Standard 1164-1993, "IEEE Recommended Practice for Load Sharing of Parallel Transformers." This standard provides guidelines and best practices for the design and operation of parallel-connected transformers, including methods for load sharing and protection against imbalances.

Additionally, the "Handbook of Electric Power Calculations" by H. Wayne Beaty includes sections on transformer load sharing and parallel operation, providing a practical guide for engineers and technicians involved in transformer design and operation.

IMPLEMENTATION

Transformer Selection: The first step in designing parallel operation of transformers is to select the transformers with the same voltage rating, phase sequence, and turn ratio. The transformers should also have similar impedance values to ensure load sharing.

Impedance Matching: The next step is to ensure impedance matching between the transformers. This is important to ensure equal sharing of the load between the transformers. The impedance values can be matched by using impedance matching transformers or by adjusting the tap settings of the transformers.

Protection: Proper protection is necessary for parallel operation of transformers. This includes overcurrent protection, differential protection, and overvoltage protection. The protective devices must be coordinated to ensure selective tripping of the faulty transformer.

Synchronization: The transformers must be synchronized before they are connected in parallel. This involves matching the phase sequence, frequency, and voltage level of the transformers.

Connection: Once the transformers are synchronized and the impedance values are matched, the transformers can be connected in parallel. Then the primary windings are connected to the same power source, and the secondary windings are connected in parallel.

Testing: After the transformers are connected in parallel, they must be tested to ensure proper operation. This includes testing for load sharing, voltage regulation, and efficiency.

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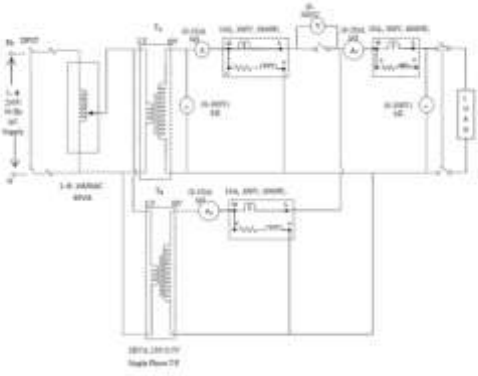
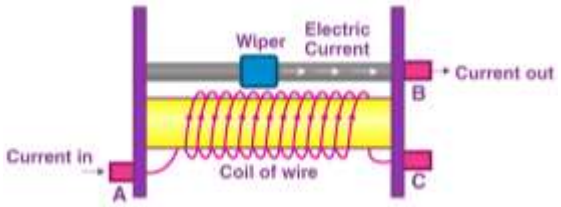
Load Sharing Techniques: Depending on the application and load characteristics, load sharing techniques may need to be implemented to ensure that the load is distributed evenly among the transformers. These techniques may include adjusting the tap settings on the transformers, using load-sharing transformers, or using additional control devices such as phase-shifting transformers or auto-transformers.

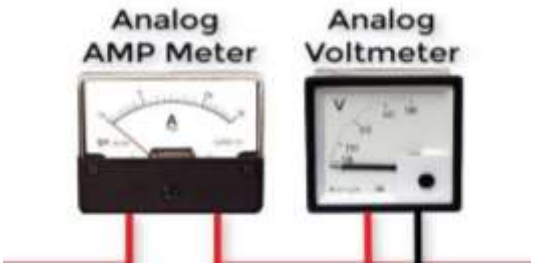
Grounding: Properly ground the transformers and the system in accordance with local electrical codes and regulations to ensure safety and reliability.

Maintenance: Establish a regular maintenance program for the transformers and associated equipment, including inspection, testing, and preventive maintenance, to ensure long-term reliability and performance of the parallel operation.

SAMPLE SCREENS







CONCLUSION

Load sharing between an isolation transformer and a tap-changing transformer

requires careful design and implementation to ensure safe and reliable operation. The load sharing system can be designed using a variety of techniques such as current transformers, voltage control, tap changers, and phase shifters.

The calculations involved in load sharing depend on the specific system and design requirements and include impedance matching, current sharing ratio, and load sharing calculations. It is important to consult with a qualified electrical engineer to ensure proper installation and implementation of the load sharing system. By carefully designing and implementing load sharing, the system can ensure even distribution of load between transformers, improved efficiency, and protection of the system and equipment from overloading and damage.

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