



Title

Transformer Tap changer

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1 / Introduction:

A tap changer is a device used in electrical power transformers to regulate the voltage level of the transformer's output. Transformers are essential components in power distribution systems, and they help to step up or step down the voltage as needed for efficient transmission and distribution of electrical energy.

The tap changer allows for adjustments to the transformer's turns ratio, which in turn changes the output voltage. This is important because the voltage levels in a power grid may vary due to factors such as load fluctuations, line losses, and other operational considerations. By adjusting the turns ratio through the tap changer, the transformer can maintain a more stable and desired output voltage.

Tap changers can be either on-load or off-load, depending on whether the adjustment is made while the transformer is energized (on-load) or de-energized (off-load). On-load tap changers are particularly useful in situations where continuous voltage regulation is required, as adjustments can be made without interrupting the power supply.

In summary, a tap changer is a crucial component in power transformers that allows for the adjustment of the transformer's output voltage to ensure a stable and reliable power supply in electrical distribution systems.

There are several types of tap changers used in power transformers, each with its own characteristics and applications. The two main categories are on-load tap changers (OLTC) and off-load tap changers (OLTC). Here are some common types within these categories:

1. On-Load Tap Changers (OLTC)
2. Off-Load Tap Changers (OLTC)

2 / On-Load Tap Changers (OLTC) are devices used in power transformers to adjust the transformer's turns ratio and, consequently, the output voltage without interrupting the power supply. Unlike off-load tap changers, on-load tap changers allow adjustments to be made while the transformer is energized, allowing for continuous and uninterrupted power delivery. OLTCs are particularly useful in situations where maintaining a stable and regulated voltage is crucial.

Features and aspects of On-Load Tap Changers:

2.1 Continuous Voltage Regulation: On-load tap changers enable the transformer's output voltage to be adjusted continuously to compensate for fluctuations in the power grid, changes in load, and other operational variations. This helps ensure a stable and reliable power supply.

2.2 Automatic or Remote Control: On-load tap changers can be operated manually, remotely, or automatically. Automatic tap changers are often equipped with control systems that monitor the voltage and initiate tap changes as needed to maintain the desired voltage level.

2.3 Types of On-Load Tap Changers:

2.3.1 Resistance Type:

A Resistance Type tap changer is a specific type of On-Load Tap Changer (OLTC) used in power transformers. It is designed to adjust the transformer's turns ratio and, consequently, the output voltage by varying the resistance in the tap changer circuit. The primary purpose of using resistance in this type of tap changer is to control the amount of voltage change and achieve the desired output voltage level.

Features and characteristics of Resistance Type tap changers:

- **Adjustment Mechanism:** The tap changer includes a variable resistor that can be adjusted to change the effective turns ratio of the transformer. By changing the position of the tap and adjusting the resistance, the voltage across the transformer winding can be controlled.

- **Continuous Adjustment:** Resistance Type tap changers allow for continuous adjustment of the transformer's output voltage while the transformer is in operation. This makes them suitable for applications where voltage regulation needs to be dynamic and responsive to changes in the electrical system.

- **Application:** These tap changers are commonly used in power distribution networks, substations, and industrial settings where maintaining a stable and regulated voltage is crucial for the proper functioning of electrical equipment.

- **Advantages:**
 - Enables precise and continuous voltage regulation.
 - Relatively simple design and construction.
 - Can be operated remotely or automatically for improved efficiency.

- **Maintenance:** Regular maintenance is necessary to ensure the proper functioning of Resistance Type tap changers. This includes checking and cleaning the contacts, inspecting the resistor elements, and verifying the overall condition of the tap changer.

2.3.2 Reactor Type:

A Reactor Type tap changer is a specific category of On-Load Tap Changer (OLTC) used in power transformers. The Reactor Type tap changer utilizes inductive devices, typically reactors, to modify the transformer's turns ratio and, consequently, regulate the output voltage. The inclusion of reactors in the tap changer circuit allows for efficient and controlled adjustments to the transformer's voltage.

Features and characteristics of Reactor Type tap changers:

- **Inductive Reactor:** The tap changer incorporates inductive devices, such as reactors or chokes, in its design. These devices are used to control the flow of current and adjust the voltage in the transformer winding.
- **Adjustment Mechanism:** By changing the position of the tap and varying the inductance provided by the reactors, the Reactor Type tap changer modifies the turns ratio of the transformer, thus adjusting the output voltage.
- **Continuous Adjustment:** Similar to other On-Load Tap Changers (OLTC), Reactor Type tap changers enable continuous adjustment of the transformer's output voltage while the transformer is in operation. This is particularly useful for applications where dynamic and responsive voltage regulation is required.
- **Applications:** Reactor Type tap changers are commonly employed in power distribution systems, substations, and industrial settings where precise and continuous voltage regulation is essential.
- **Advantages:**
 - Provides efficient and controlled adjustment of the transformer turns ratio.
 - Allows for continuous and dynamic voltage regulation.

- Can be operated manually, remotely, or automatically.

- **Maintenance:** Regular maintenance is necessary to ensure the proper functioning of Reactor Type tap changers. This includes inspections, cleaning, and any necessary repairs or replacements to ensure the reliability of the tap changer over time.

It's important to note that there are various types of tap changers, each with its own characteristics and applications. The choice of tap changer type depends on factors such as the specific requirements of the application, the size of the transformer, and the desired level of automation in voltage regulation.

2.3.3 Vacuum Type:

A Vacuum Type tap changer is a specific type of On-Load Tap Changer (OLTC) used in power transformers. This type of tap changer employs vacuum interrupters to achieve tap changes on load, allowing for continuous voltage regulation without interrupting the power supply. Vacuum Type tap changers offer advantages such as fast switching times, reduced maintenance, and improved reliability compared to some traditional tap changer technologies.

Features and characteristics of Vacuum Type tap changers:

- **Vacuum Interrupters:** The core component of a Vacuum Type tap changer is the vacuum interrupter. A vacuum interrupter is a switch that uses a vacuum to extinguish the arc produced during tap changing. This technology is known for its high dielectric strength and arc-quenching capabilities.
- **On-Load Operation:** Vacuum Type tap changers enable tap changes while the transformer is energized, allowing for continuous voltage regulation without disrupting the power supply.

- **Fast Switching Times:** Vacuum interrupters provide rapid and efficient arc extinguishing, resulting in fast switching times during tap changes. This can be advantageous in applications where quick response to voltage fluctuations is critical.

- **4. Reduced Maintenance:** Vacuum interrupters require less maintenance compared to some other tap changer technologies, such as oil-filled or air-type tap changers. The absence of oil or gas in the interrupter chamber contributes to a cleaner and more reliable operation.

- **Applications:** Vacuum Type tap changers are commonly used in various power distribution systems, substations, and industrial settings where maintaining a stable and regulated voltage is crucial.

- **Advantages:**
 - Enables on-load tap changes for continuous voltage regulation.
 - Fast switching times contribute to efficient and responsive voltage adjustment.
 - Reduced maintenance requirements compared to some other tap changer technologies.

- **Maintenance:** While Vacuum Type tap changers generally require less maintenance, periodic inspections and cleaning are still necessary to ensure optimal performance. Regular maintenance helps identify and address any issues that may arise over time.

The choice of tap changer type, including Vacuum Type, depends on factors such as the specific requirements of the application, the size of the transformer, and the desired level of automation in voltage regulation.

2.3.4 Electronic Type:

An Electronic Type tap changer is a modern and advanced form of On-Load Tap Changer (OLTC) used in power transformers. Unlike traditional tap changers that rely on mechanical or electromagnetic methods, Electronic Type tap changers use electronic components, such as power semiconductors, to achieve continuous and precise adjustments to the transformer's turns ratio and output voltage.

Features and characteristics of Electronic Type tap changers:

- **Semiconductor Devices:** Electronic Type tap changers use power semiconductor devices, such as thyristors or insulated gate bipolar transistors (IGBTs), to control the flow of current and adjust the voltage. These devices allow for precise and rapid changes in the transformer's turns ratio.
- **On-Load Operation:** Similar to other On-Load Tap Changers (OLTC), Electronic Type tap changers enable tap changes while the transformer is energized, ensuring continuous voltage regulation without interrupting the power supply.
- **Fast and Precise Adjustments:** The use of electronic components enables fast and precise adjustments to the transformer's turns ratio, providing highly accurate voltage regulation. This is particularly advantageous in applications where tight voltage control is essential.
- **Automated Control Systems:** Electronic Type tap changers are often integrated with sophisticated control systems. These systems can be programmed to automatically adjust the tap settings based on real-time measurements of voltage, load conditions, or other parameters, optimizing the transformer's performance.

- **Reduced Mechanical Wear:** Since Electronic Type tap changers do not rely on mechanical contacts for tap changes, they generally experience reduced wear and tear compared to some traditional tap changers. This can contribute to longer service life and lower maintenance requirements.

- **Applications:** Electronic Type tap changers find applications in modern power distribution networks, smart grids, and advanced industrial settings where precise and automated voltage regulation is critical.

- **Advantages:**
 - Provides precise and rapid adjustments to the transformer's output voltage.
 - Enables automation and integration with advanced control systems.
 - Reduced mechanical wear and potentially lower maintenance requirements.

- **Maintenance:** While Electronic Type tap changers may have lower mechanical wear, periodic inspections and maintenance are still necessary to ensure the reliable operation of electronic components and control systems.

2.4 Applications: On-load tap changers are commonly used in power distribution networks, substations, and industrial settings where maintaining a stable voltage is critical for the proper functioning of electrical equipment.

3 / Off-Load Tap Changers (OLTC):

Off-Load Tap Changers, also known as de-energized tap changers or no-load tap changers, are devices used in power transformers to adjust the turns ratio and, consequently, the output voltage. Unlike On-Load Tap Changers (OLTC), Off-Load Tap Changers require the transformer to be de-energized (turned off) during the tap-changing process. This means that the transformer is taken out of service temporarily while the taps are adjusted.

Aspects of Off-Load Tap Changers include:

3.1 De-Energized Operation: The transformer is disconnected from the power source during the tap-changing process. This ensures the safety of personnel involved in the maintenance or adjustment.

3.2 Manual or Motorized Operation: Off-Load Tap Changers can be manually operated by turning a handle or using a motorized mechanism to rotate the tap changer.

3.3 Types of Off-Load Tap Changers:

3.3.1 Drum Type:

A Drum Type Off-Load Tap Changer (OLTC) is a specific configuration of tap changer used in power transformers. Unlike On-Load Tap Changers (OLTC), Drum Type Off-Load Tap Changers are designed to make adjustments to the transformer taps while the transformer is de-energized or turned off. These tap changers are typically used during maintenance activities or when temporary disconnection of the transformer is acceptable.

Here are some key features and characteristics of Drum Type Off-Load Tap Changers:

- **De-Energized Operation:** Drum Type Off-Load Tap Changers require the transformer to be de-energized during the tap-changing process. This ensures the safety of personnel working on the transformer.
- **Drum Mechanism:** Similar to Drum Type On-Load Tap Changers, Drum Type Off-Load Tap Changers use a rotating drum that carries multiple tap positions. By manually or mechanically rotating the drum, the tap positions are changed without electrical connection to the transformer winding.
- **Multiple Tap Positions:** The drum typically has multiple tap positions, allowing for a selection of different turns ratios. The choice of tap position determines the voltage level when the transformer is re-energized.
- **Manual or Motorized Operation:** Drum Type Off-Load Tap Changers can be operated manually by turning a handle or using a motorized mechanism to rotate the drum. Motorized operation is common in larger transformers or where manual operation is impractical.
- **Applications:** Drum Type Off-Load Tap Changers are commonly used during routine maintenance or when adjustments to the turns ratio are needed without applying voltage to the transformer winding.
- **Advantages:**
 - Allows for tap changes without energizing the transformer.
 - Simple and robust mechanical design.
 - Suitable for applications where temporary disconnection is acceptable.

- **Maintenance:** Regular maintenance is required for Drum Type Off-Load Tap Changers to ensure the proper functioning of mechanical components, the rotating drum, and the tap positions. This may include inspections, cleaning, and lubrication.

While Drum Type Off-Load Tap Changers are suitable for certain applications, it's important to note that On-Load Tap Changers are preferred in situations where continuous voltage regulation without interruption is critical. The choice between On-Load and Off-Load Tap Changers depends on specific application requirements and safety considerations.

3.3.2 Lever Arm Type:

A Lever Arm Type Off-Load Tap Changer is a specific configuration of tap changer used in power transformers. Off-Load Tap Changers are designed to make adjustments to the transformer taps while the transformer is de-energized or turned off. Lever Arm Type Off-Load Tap Changers use a lever mechanism to change the tap position manually or with the assistance of a motorized mechanism.

Features and characteristics of Lever Arm Type Off-Load Tap Changers:

- **De-Energized Operation:** Lever Arm Type Off-Load Tap Changers require the transformer to be de-energized during the tap-changing process. This ensures the safety of personnel working on the transformer.
- **Lever Mechanism:** Instead of a rotating drum, Lever Arm Type Off-Load Tap Changers use a lever mechanism to change the tap position. The lever is manually or motor-operated to select the desired tap position.
- **Multiple Tap Positions:** Similar to other tap changers, Lever Arm Type Off-Load Tap Changers typically have multiple tap positions, allowing for adjustments to the turns ratio.

- **Manual or Motorized Operation:** Lever Arm Type Off-Load Tap Changers can be operated manually by turning a handle or using a motorized mechanism to move the lever. Motorized operation is often used in larger transformers or when manual operation is impractical.

- **Applications:** Lever Arm Type Off-Load Tap Changers are commonly used during routine maintenance activities when adjustments to the turns ratio are required without applying voltage to the transformer winding.

- **Advantages:**
 - Allows for tap changes without energizing the transformer.
 - Simple and robust mechanical design.
 - Suitable for applications where temporary disconnection is acceptable.

- **Maintenance:** Regular maintenance is required for Lever Arm Type Off-Load Tap Changers to ensure the proper functioning of mechanical components, the lever mechanism, and the tap positions. This may include inspections, cleaning, and lubrication.

While Off-Load Tap Changers, including Lever Arm Type, are suitable for certain applications, it's important to note that On-Load Tap Changers are preferred in situations where continuous voltage regulation without interruption is critical. The choice between On-Load and Off-Load Tap Changers depends on specific application requirements, safety considerations, and the acceptability of temporary disconnection.

3.3.3 Switch Type:

A Switch Type Off-Load Tap Changer is a specific type of tap changer used in power transformers. Off-Load Tap Changers are designed to make adjustments to the transformer taps while the transformer is de-energized or turned off. The Switch Type Off-Load Tap Changer uses a switching mechanism to disconnect the transformer winding from one tap and reconnect it to another.

Here are some key features and characteristics of Switch Type Off-Load Tap Changers:

- **De-Energized Operation:** Switch Type Off-Load Tap Changers require the transformer to be de-energized during the tap-changing process. This ensures the safety of personnel working on the transformer.
- **Switching Mechanism:** Instead of a rotating drum or lever, Switch Type Off-Load Tap Changers use a switching mechanism to physically disconnect the transformer winding from one tap and reconnect it to another. This is often achieved through the use of switches or other mechanical components.
- **Multiple Tap Positions:** Similar to other tap changers, Switch Type Off-Load Tap Changers typically have multiple tap positions, allowing for adjustments to the turns ratio.
- **Manual or Motorized Operation:** The switching mechanism can be operated manually by turning a handle or using a motorized mechanism to actuate the switches. Motorized operation is often used in larger transformers or when manual operation is impractical.
- **Applications:** Switch Type Off-Load Tap Changers are commonly used during routine maintenance activities when adjustments to the turns ratio are required without applying voltage to the transformer winding.

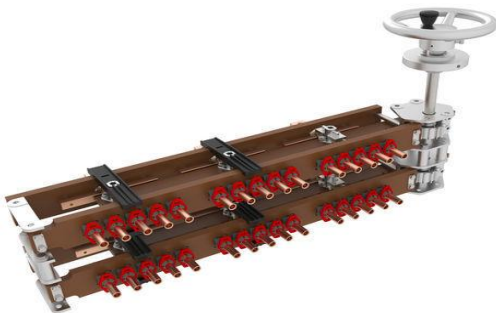
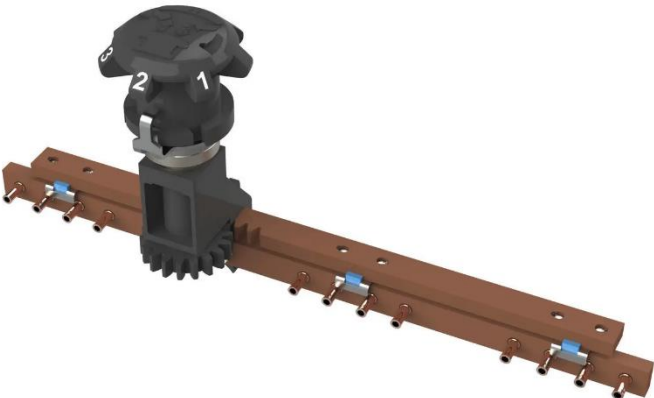
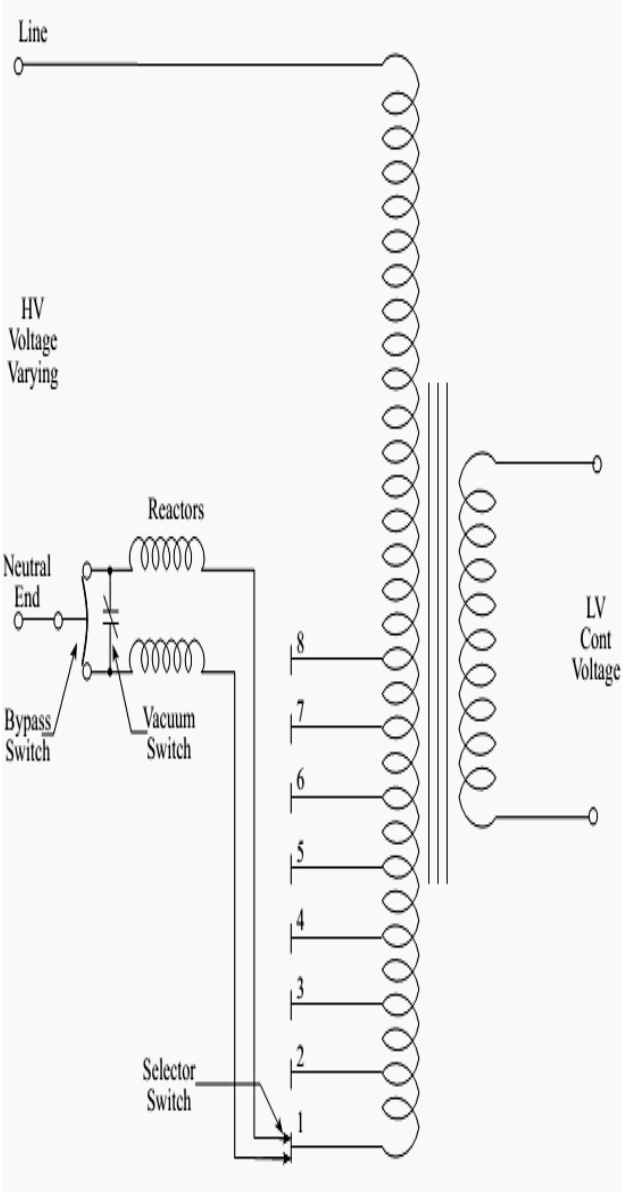
- Advantages:
 - Allows for tap changes without energizing the transformer.
 - Simple and robust switching mechanism.
 - Suitable for applications where temporary disconnection is acceptable.

- Maintenance: Regular maintenance is required for Switch Type Off-Load Tap Changers to ensure the proper functioning of the switching mechanism, contacts, and the tap positions. This may include inspections, cleaning, and lubrication.

While Off-Load Tap Changers, including Switch Type, are suitable for certain applications, it's important to note that On-Load Tap Changers are preferred in situations where continuous voltage regulation without interruption is critical. The choice between On-Load and Off-Load Tap Changers depends on specific application requirements, safety considerations, and the acceptability of temporary disconnection.

3.4 Applications: Off-Load Tap Changers are commonly used in situations where temporary disconnection of the transformer is acceptable during tap changes. This may include maintenance activities or situations where voltage adjustment does not need to be continuous.

4 / Summary of diagram and photos of tap changer :





5 / Sources:

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Content of Report:

1. Introduction

2. On-Load Tap Changers (OLTC)

- 2.1 Continuous Voltage Regulation
- 2.2 Automatic or Remote Control
- 2.3 Types of On-Load Tap Changers
- 2.4 Applications

3. OFF-Load Tap Changers (OLTC)

- 3.1 De-Energized Operation
- 3.2 Manual or Motorized Operation
- 3.3 Types of OFF-Load Tap Changers
- 3.4 Applications

4. Summary of diagram and photos of tap changer

5. Sources