ISSN: 2414-1895 DOI: 10.6919/ICJE.202204_8(4).0087

Research on Transformer Fault Simulation Device

Yuou Chen

North China Electric Power University (Baoding), Baoding 071003, China

Abstract

By adding improvements to the pulling mechanism, connectors and mounting plates, the new transformer fault simulation device can simulate transformer winding deformation faults and ensure the efficiency of winding deformation fault generation, disappearance as well as aggravation. To avoid the tediousness of replacing the fault model during fault simulation, the utility of this transformer fault simulation device is further improved by replacing the windings with different number of turns and choosing to manually lift the U-shaped lifting plate or choosing to electrically lift the U-shaped lifting plate according to the use requirements of the simulator.

Keywords

Transformer; Pulling Mechanism; Winding; Connector; Fault Simulation.

1. Introduction

A transformer is a device that uses the principle of electromagnetic induction to change the AC voltage and its main building blocks are the primary coil, secondary coil and the iron core (magnetic core) [1,2]. The main functions of transformers are: voltage transformation, current transformation, impedance transformation, isolation, voltage regulation (magnetic saturation transformers), etc. They can be classified according to their use: power transformers and special transformers [3].

The current way and method for transformer internal fault simulation is generally to use the returned transformer or directly in the transformer oil for fault simulation test, its workload is large, the fault module needs to be replaced frequently, and the simulation effect is poor. This device is based on the power simulation transformer structure and transformer fault model, through the external regulation control method directly outside the transformer body to control the transformer partial discharge fault, winding deformation fault generation, disappearance and aggravation, and can be safely adjusted in the step-up process. However, it is not easy to adjust during the regulation process, which affects the efficiency of winding deformation fault generation, disappearance and aggravation, so we improve it and propose a transformer fault simulation device.

2. Improvement and Optimization Measures for Retrofitting the Pulling Mechanism

The transformer fault simulation device is described in conjunction with Figures 1 to 2, and the improvement and optimization measures for the addition of a pulling mechanism are described. As shown in Figure 1, the new transformer fault simulation device includes an oil tank 1, an iron core 2, a low-voltage side winding 3, a shielding layer 4 and a high-voltage side winding 5, the top of the oil tank 1 is provided with two U-shaped brackets 8, the two U-shaped brackets 8 are slidingly provided with a pulling mechanism for pulling the iron core 2, the pulling mechanism includes a U-shaped lifting plate 7 slidingly located on the U-shaped bracket 8, the back ends of the U-shaped lifting plate 7 are provided with a rotating shaft 16, the rotating shaft 16 is provided with a rotating plate 6, and the two end parts of the iron core 2 are respectively located on the rotating plate 6.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202204_8(4).0087

The inner wall of U-shaped bracket 8 is opened with dovetail groove 9, and U-shaped lifting plate 7 is equipped with dovetail block 10 that slides with dovetail groove 9. When U-shaped lifting plate 7 is lifted, dovetail block 10 on U-shaped lifting plate 7 moves inside dovetail groove 9, which improves the stability of up and down movement of U-shaped lifting plate 7.

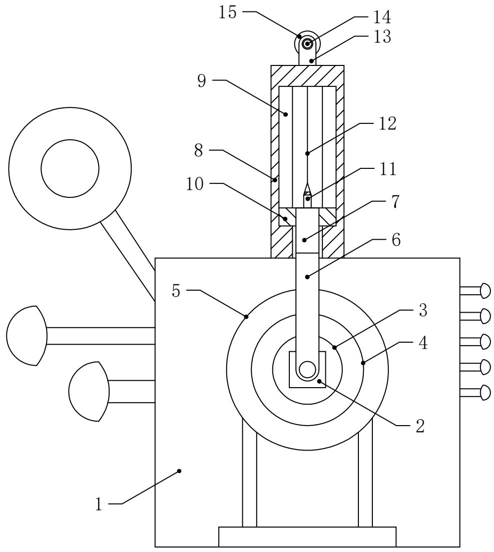

Figure 1. Schematic diagram of the structure of the transformer fault simulation device

In which, the pulling mechanism includes a U-shaped lifting plate set slidingly on the U-shaped support. When the transformer winding deformation fault needs to be generated, manually lift up the U-shaped lifting plate, the U-shaped lifting plate drives the rotation axis upward movement, the rotation axis drives the rotation plate upward movement, the rotation plate drives the core upward movement and close to the low-voltage side winding, it will make the distance between the core and the winding change, the transformer winding capacitance, impedance and other characteristics change, to achieve the simulation of transformer winding deformation fault generation. When you need to aggravate the degree of winding deformation fault, you can continue to lift the U-shaped lifting plate upward will achieve the simulation of transformer winding deformation aggravation; when you need to eliminate the transformer winding deformation fault, you only need to release the U-shaped lifting plate, in the U-shaped lifting plate under the action of its own gravity downward movement, in the U-shaped lifting plate on the bottom end of the contact with the oil tank after the core just in the middle of the low-voltage side of the winding.

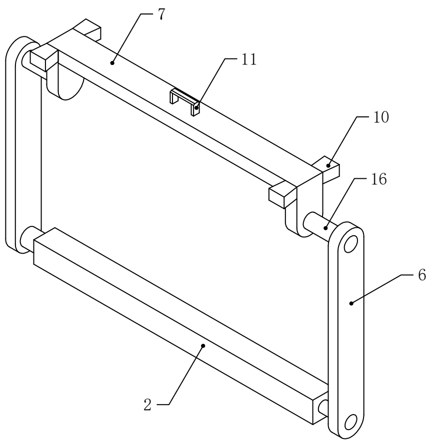

Figure 2. Schematic diagram of the connection structure of U-shaped lifting plate and rotating plate

3. Improvement and Optimization Measures for Retrofitting Connections

As shown in Figures 2 and 3, the core 2 is connected to the rotating plate 6 by a connection member, which includes a mounting slot 17 opened at the end of the core 2, a reset spring 18 inside the mounting slot 17, a connecting rod 19 at the end of the mounting slot 17, and a connecting hole opened on the rotating plate 6 for the connecting rod 19 to pass through, so that when the transformer fault is simulated, the windings with different number of turns can be replaced, and when the windings with different number of turns are replaced, the connecting rod 19 is pushed, and the connecting rod 19 moves into the mounting slot 17 at the end of the core 2 and compresses the reset spring 18. When replacing the windings with different number of turns, push the connecting rod 19, the connecting rod 19 moves into the mounting slot 17 at the end of the core 2 and compresses the reset spring 18, removes the rotating plate 6 from the connecting rod 19, rotates the rotating plate 6 half a turn around the rotation axis 16, removes the original winding outside the core 2 and replaces it with a new one, then rotates the rotating plate 6 back to the original position and makes the connecting rod 19 pass through the rotating plate 6 by the elastic potential energy of the reset spring 18. Then turn the rotating plate 6 back to its original position and make the connecting rod 19 pass through the connecting hole on the rotating plate 6 under the action of the elastic potential energy of the reset spring 18, which makes it easy to replace the windings with different turns and further improves the practicality of the transformer fault simulation device.

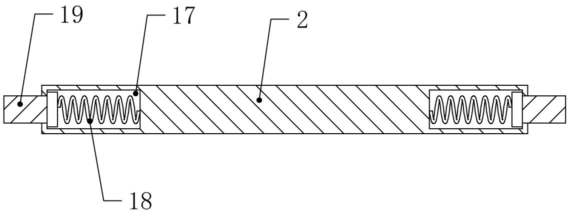

Figure 3. Schematic diagram of core structure section

4. Improvement and Optimization Measures for Retrofitting Mounting Plates

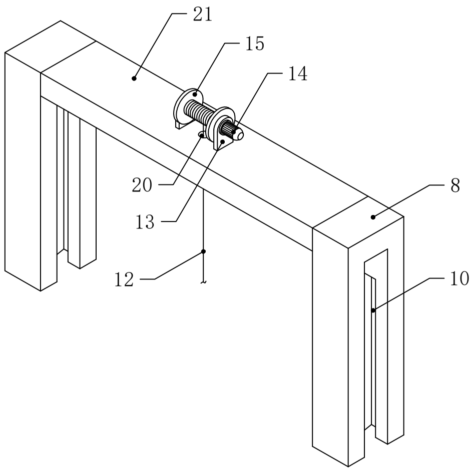

Figure 4. Schematic diagram of U-shaped bracket structure

As shown in Figure 4, there is a mounting plate 21 between the two U-shaped brackets 8, the top of the mounting plate 21 is provided with a rope winding wheel 15 via the mounting base 13, the mounting base 13 is installed with a drive motor 14 for driving the rotation of the rope winding wheel 15, the rope winding wheel 15 is wound with a sling rope 12 connected with the handle 11, the mounting plate 21 is opened for the rope 12 through the stringing hole 20, in the need to produce transformer winding Deformation fault, can also be driven by the output end of the drive motor 14 rope wheel 15 rotation, rope wheel 15 rotation on the rope 12 to tighten, so that the rope 12 pull U-shaped lifting plate 7 upward movement, according to the needs of the simulator to choose manual lifting U-shaped lifting plate 7 or choose electric lifting U-shaped lifting plate 7, to further improve the practicality of the transformer fault simulation device.

5. Conclusion

The improved and optimized transformer fault simulation device is slidingly provided with a pulling mechanism for pulling the iron core on two U-shaped supports. By pulling the U-shaped lifting plate to drive the rotating shaft movement, the transformer winding capacitance, impedance and other characteristics are then changed to realize the simulation of transformer winding deformation fault generation. The core is connected to the rotating plate by a connector so that the windings of different turns can be replaced during the simulation. A mounting plate is provided between the two U-shaped supports, which can be manually lifted by the U-shaped lifting plate or electrically lifted by the U-shaped lifting plate, depending on the usage requirements. The optimized transformer fault simulation device ensures efficiency in the generation, disappearance and aggravation of winding deformation faults and avoids the tedious replacement of fault models during fault simulation.

References

[1] Peng Dan. Design and Process Research of Insulation Breakdown Test Bench [D]. North China Institute of Aerospace Technology.

[2] Yang Hongtao. Lightning protection of substation transformers [J]. China Information Technology, 2013.

[3] Li Daiqi. Transformer operating characteristics analysis[J]. China Science and Technology Expo, 2011(20):1.

[4] Han Zhenmei. On the application of virtual reality technology in television production [J]. The application of virtual reality technology in television production[J].

[5] Shi Yuhang. An introduction to the development status and application of virtual reality [J]. Chinese information, 2019, 000(001):20.