Research to Prevent the Anti-charging Incident of the Voltage Transformer in the Substation

Hui-Ying Chen, Zhi-Peng Wang, and Mu-Qin Tian

College of Electrical and Power Engineering, Taiyuan University of Technology,
West Yingze Street No.79, 030024 Taiyuan, Shanxi, China
tianmuqin@tyut.edu.cn

Abstract. The voltage transformer of the power system is a device which converts the high voltage of the primary side into the low voltage required by secondary device, and the primary side connects to the primary system, the secondary side connects to the measuring instrument, relay protection equipment and so on. This paper Introduces a kind of air switch with the ability of preventing the anti-charging occurring in the voltage transformer from secondary side of the to primary side in the ordinary air switch used in the practice. It will automatically handle the anti-charging phenomenon and protect the safety of the staff and equipments more effectively.

Keywords: Voltage transformer, anti-charging, tripper, automatic processing.

1 Introduction

There are many reasons to cause the anti-charging from secondary side to the primary side of the voltage transformer. They are as follows: the parallel switching when the multi-buses running, wrong connecting the power bus into the blackout bus of the secondary side when maintenance personnel works in the secondary side, connecting the power bus and the blackout bus due to the secondary parasitic circuit caused by the disordered wire-connect of voltage transformer secondary side. In order to fundamentally solve the incident, this paper presents a kind of air switch with the ability for preventing the anti-charging.

2 Accident Analysis

It is discovered that the accident of the voltage transformer anti-charging mainly occurs in the parallel switch operation in the practical work, the following will analyze the anti-charging accident base on the operation.

The parallel switch operation of the voltage transformer secondary side means that voltage transformer secondary side can be switched parallel in order to ensure that the primary side devices work continually and secondary side devices such as measuring

H. Deng et al. (Eds.): AICI 2011, CCIS 237, pp. 135–140, 2011.

instrument, relay protection equipment and so on get voltages corresponding to the primary voltage when one of the voltage transformer working in double-bus or sectionalized single-bus configuration will be maintained for any reason.

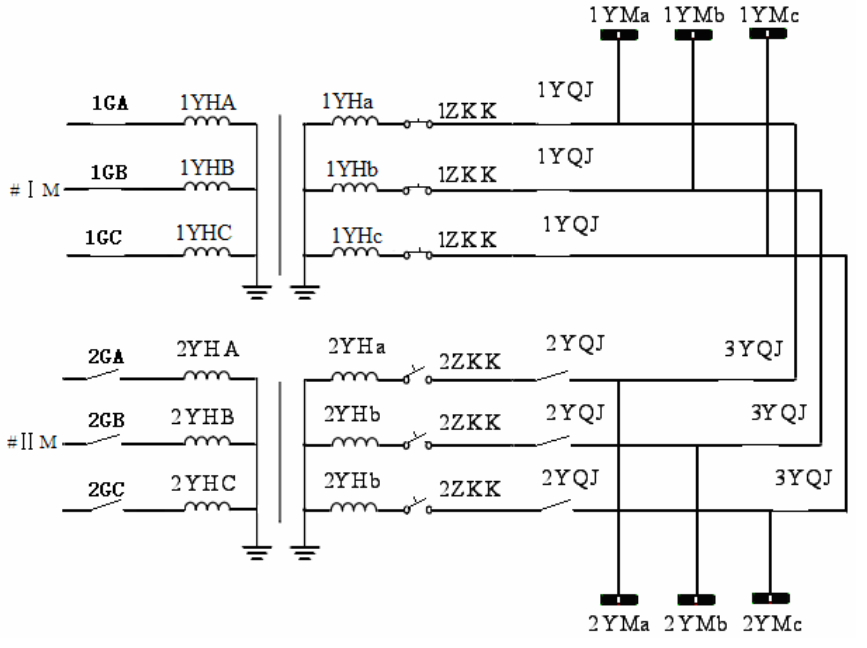

Fig. 1. The parallel and switch operation of the voltage transformer three-phase AC circuit

The Fig.1 shows the parallel switch operation of the voltage transformer in the three-phase AC circuit where YM is small bus, YH is voltage transformer, ZKK is air switch, YQJ is voltage switching contact, G is linked switch. It is supposed that 2YH will be Maintained outage, normally the air switch of 2ZKK is disconnected in the first, then 2YQJ is switched off through the linked switch of 2G, the contact 3YQJ is closed at last. In this way, the small busbar of 2YH side don't lose power and the circuit attains the effect of the parallel switch operation.

One of functions of the air switch is to prevent the accident of the anti-charging, but the function must be achieved by the manual operation, so it is easy to cause the false operation or not operation in the practice. If the linked switch doesn't make the YQJ contact completely disconnect, the accidents will happen. By the fig.2 it is known that the voltage of the secondary side inversely transfers to the primary side of the II bus's voltage transformer, it will lead to a capacitive current on the primary side equipment of the II busbar. A high-current may be produced by this current in the secondary circuit once again. The air switch only has the function of the overcurrent protection and undervoltage protection, and this moment the 1ZKK and 2ZKK of the air switch will all trip because of the high-current. The situation will cause the serious harm for the overhaul workers on the primary side and the equipment of the

secondary side. At the same time, If the high-current passes the zero sequence voltage circuit long time, it will burn out the zero sequence voltage parallel relay in the voltage transformer's parallel plug-in because there is not the air switch in the zero sequence voltage circuit[1-2].

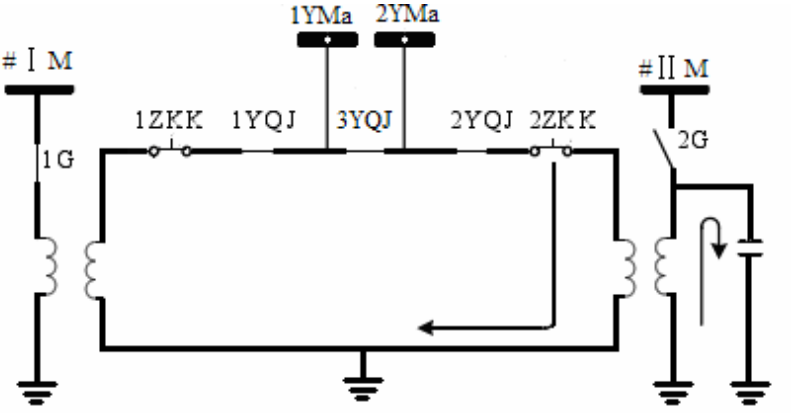

Fig. 2. The schematic of the harm of the voltage transformer anti-charging

3 The Present Preventive Measure

At present, the phenomenon of the anti-charging is usually prevented by the following measure: switching off the air switch of the secondary side of the voltage transformer, taking off the fuse of the secondary side of the voltage transformer and setting up the ground line on the conductor of the primary side of the voltage transformer and so on.

However, there are mistakes in implementation of the security measures in the practice. The common failure of the ground line such as the installation error, the missing installation, the non-standard installation led to the poor contact and so on. The common failure of the switching operation such as the secondary air switch being not opened, the insurance being not removed, the air switch having been pulled off but actually it being not been disconnected, the secondary side auxiliary contact having bad conversion.

4 A Kind of Air Switch with the Ability for Preventing the Anti-charging

Through the above analysis with the technique actual and the engineering requirement, the solution of the preventing the anti-charging accident has been proposed.

1) The wiring should be connected strictly according to the relational procedure in the design of the secondary electrical, and artificially short or fumble connecting of some contacts of the secondary equipment are not allowed.

2) The corresponding air switch of the secondary side of voltage transformer must be cut when cutting off the voltage transformer.

This paper presents a kind of air switch with the ability for preventing the anti-charging, which means that we set a kind of tripping device with a function of anti-charging. The Security risks have been fundamentally solved to achieve the purpose of the automatic processing of the accident.

The air switch consists of three parts: the contact and the system of the arc-control (the part of opening and closing circuit), all kinds of tripper (detecting the abnormal state of the circuit and then making response, that is the part of the protective action), the mechanism of the operation and the automatic tripper (the part of the middle contact). The Fig.3 is schematic diagram of the air switch with the ability for the preventing the anti-charging.

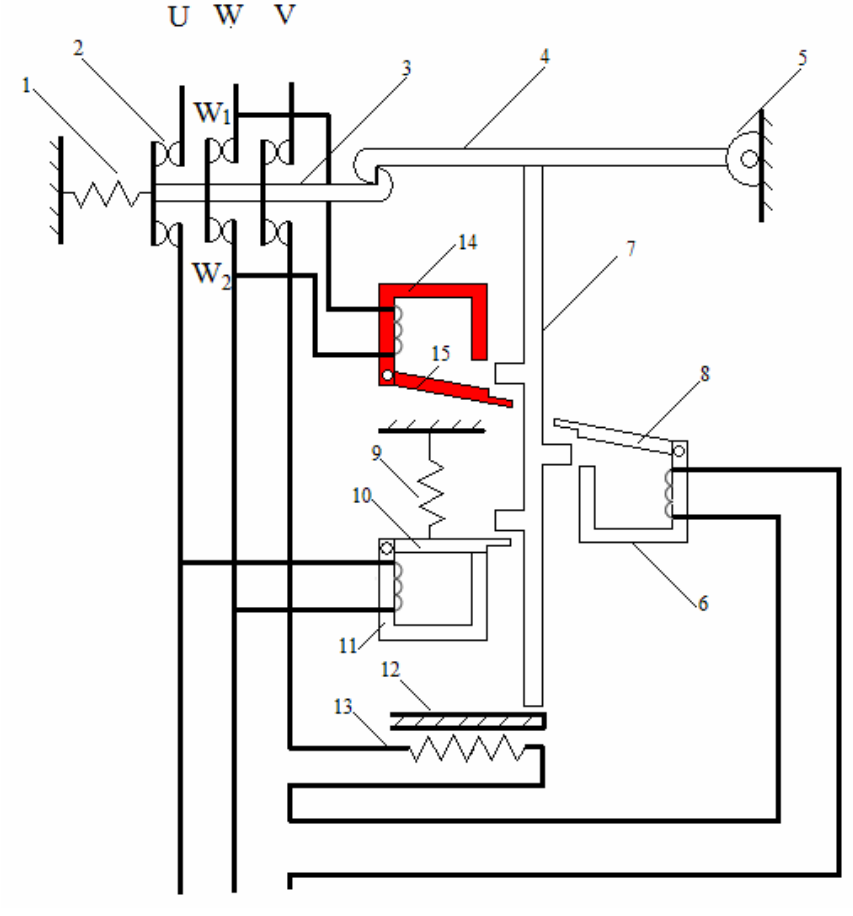

Fig. 3. The schematic diagram of the air switch with the ability for preventing the anti-charging

In the Fig.3, the contact 2 has three pairs of switches that are in series in the protected circuit. The button is pulled to the position of the “close” by the hand, and then the contact 2 keeps close condition by the locking key 3, the locking key 3 is supported by the agraffe 4. If we want to break the switch, we need pull the button to the position of “open”, and the agraffe 4 is hit by the lever 7(the agraffe 4 can rotate around the axis 5), the contact 2 is undrawn off by the spring 1, then the circuit is disconnected.

The automatic disconnection of the air switch is made up of the magnetic tripper 6, undervoltage tripper 11, thermal overload tripper 12 and the new anti-charging tripper 14.

The air switch can equip the different tripper by the different purpose.

The coil of the magnetic tripper 6 is in series with the circuit, the armature 8 is controlled by the current in the circuit, and then the air switch is disconnected through the lever 7of being hit.

The coil of the undervoltage tripper 11 is parallel with the circuit. The armature 10 is controlled by the voltage in the circuit. The bimetallic strip is bent because the overcurrent pass the heating element 13 of the thermal overload tripper 12 when the over loading in the circuit, which is used for the protection of the over loading.

The coil of the anti-charging tripper 14 is paralleled on both ends W1W2(or other auxiliary contact position) of the air switch. The air switch is closed at both ends when the circuit properly works so it doesn’t have voltage and current, the coil of the anti-charging tripper 14 doesn’t act. The coil of the anti-charging tripper 14 will act when the air switch’s top W1 doesn’t have power but its bottom W2 has power, and the armature 15 bumps the lever 7 and hit agraffe 4, and then the circuit is disconnected by the contact 2. It can prevent the accident of the anti-charging.

At present, there are four kinds of the anti-charging tripper, it is respectively AC/DC12V~24V, AC/DC24V~48V, AC110V~127V, AC230V~400V. We found that the first two kinds have high rates of the accident of the anti-charging, the other have low rate. We also found that the smaller voltage (e.g. 1V, 6V) has high rate besides the above voltage standard, and similar dangers exist in the accident. According to the actual process and measurement accuracy, these low voltages aren’t achieved by the tripper.

To the accident of the low voltage, the low tension transformer is used in the circuit. The Fig. 4 shows the low tension transformer 16 is in series with both ends W1W2. The low voltage side connects the main circuit, the high voltage side connects the tripper of the anti-charging. The existing low voltage is changed to the voltage level of the existing by the low tension transformer when there are the accident of the low voltage of the anti-charging, then the air switch is disconnected by the tripper of the anti-charging.

Finally, we can increase 5 to 6 trippers (the operation voltage is 1 V, 6 V, 12 V, 24 V, 48V and so on) according to actual situation to expand the adaptive. Not only it provides convenience for the user but also it improves the value in use.

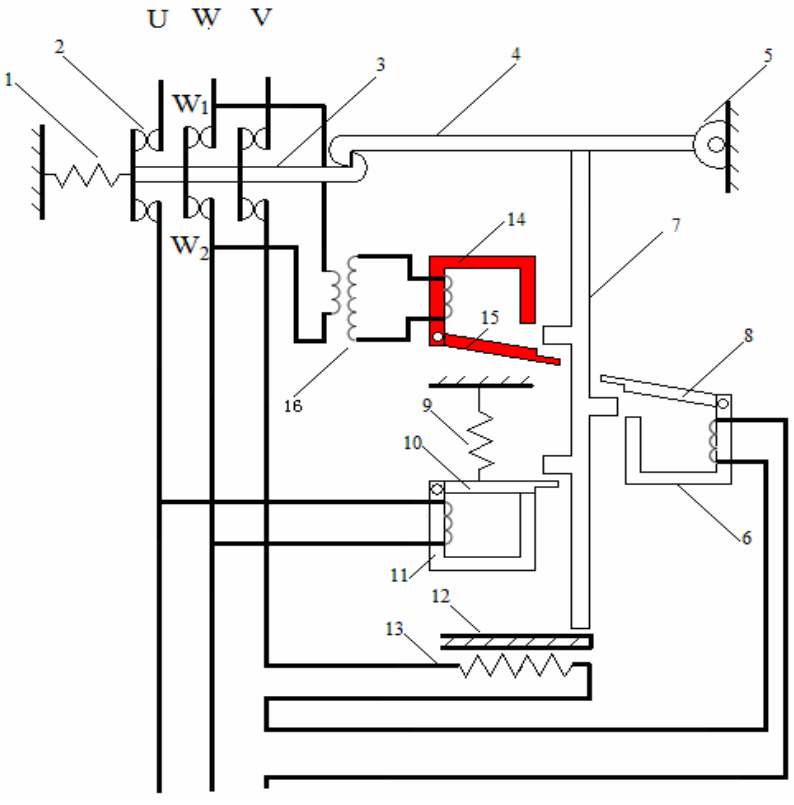

Fig. 4. The schematic diagram of the air switch with the ability for preventing the anti-charging and low tension transformer transformer

5 Conclusion

The air switch with the ability for preventing the anti-charging can improve the safety for the maintenance of outage, and advance the level of management for the power system. The accident is basically avoided by this device. It has many advantages as simple structure, convenient installation, easy maintains. This device doesn't have the standby circuit, it provides the safe assurance to the other equipments, and it also increases the value of use and promotion.

References

1. Wu, J.-h., Li, M.-c., Sun, J.-p.: Thinking of two anti-charging incidents of voltage transformer. Power System Protection and Control 38(13), 124–129 (2010)
2. Zhang, J.-h.: Analysis and Improvement Measures of the Secondary Reversed Feeding. Jiangsu Electrical Engineering 30(1), 39–41 (2011)