Development and Application of adjustable soft ladder head of transmission lines

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Abstract. Soft ladder head was mainly used for connecting soft ladder and hangs from a convenient tools for live working on the wire in areas of existing transmission technology. Usually it includes a ladder head rectangular frame. Head on top of the frame is installed in the escape of at least two side-by-side pulleytype hook. Pulley type hook into a curved hook. Bending coupler overlap there is between the pulley. Pulley wheel surface of hook is on the wire. Implementation of sliding go along with the wires. The lower end of the frame is welded with hanging rings connected with the soft ladder. The ladder frame is made of aluminium alloy. The stability of the soft ladder is good, the safety factor is high, and the overhaul personnel work at high altitude becomes relaxed and happy. The soft ladder head of vertical double-split conductor is fixed structure[3-5]. However, the distance between two vertical bundled conductors of domestic transmission lines is not the same distance. This requires the maintenance department to equip with a number of software heads. If you are not familiar with the line situation, you need to bring a number of solutions. This makes it impossible for the original ladder head to realize a set of ladder heads for various purposes. It does not have generality, increases cost and affects work efficiency.

1. Introduction
Most of them are high in transmission line maintenance job. So often used in climbing equipment. Existing climbing equipment was installed by hanging rods, mainly in the suspension rail line on the ladder hanging from the bottom of the suspension rail wheels and composition. The climbing equipment is divided into one-wire and two-wire type[1-5]. Difference between the spacing between two bundled conductors are usually larger[7-10]. Maintenance according to the distance between the wires is required when replacing soft ladder head. High production costs, transport space, not easy to carry, and do not have the versatility. Lead to workers in labor-intensive, labor-intensive and time-consuming, and there are many disturbing factors. A certain threat to personal safety of workers. In order to better meeting the needs of different power maintenance work, need to reform the existing soft ladder head. Transmission overhaul of this article come up with a new device to solve these problems in the existing soft ladder climbing equipment head[11-12].

2. Technology solutions
Due to the difference of the distance between the upper and lower hooks of the vertical double-split conductor's soft ladder head. In this paper, a kind of adjustable soft ladder head for transmission lines with different spacing can be adapted by adjusting the spacing. It can also dismantle the upper hanging point pulley and be used on single wire lines.

The technical solution of the utility model is that the adjustable soft ladder head of the transmission line includes a ladder, and the upper and lower ends of each side of the ladder bar are arranged with
upper and lower pulley hooks. The ladder bar between the upper and lower pulley hooks adopts a movable adjustable length two-body connection structure. It can adjust the distance between upper and lower pulley hooks to meet the distance between the connecting wires.

In the above scheme, a plurality of transverse perforations are arranged between the ladder rods of the two-body connection structure, and the transverse perforations are connected by bolts. The two-body structure of the ladder rod is connected or plugged. For the docking structure, the upper pulley hook is connected downward with a ladder rod, the lower end of the ladder rod is connected with a solid square rod, and the square rod is perforated along the upper and lower intervals. The upper end of the lower pulley hook is fixedly connected with a solid square beam with two horizontal perforations arranged up and down on the solid square beam.

We changed the upper hook of the soft ladder head of the fixed vertical double-split conductor into adjustable split bolt connection mode. The bolt connection part adopts porous structure, which can realize the purpose of adjusting the length.

The advantage of the utility model is that it can be used on the vertical arrangement of double split wire lines with different wire spacing. You can also remove the hanging-point pulley and use it on a single wire line. Versatility, ease of use, reduced tooling and cost savings.

3. Description of figures

Figure 1 is a brief diagram of the structure of the utility model. Figure 2 is a sketch of the right-hand structure in Figure 1. Figure 3 is a sketch of the structure of the solid square rod. Figure 4 is a sketch of the right-hand view structure in Figure 3. Figure 5 is a sketch of the structure of the solid square beam. Figure 6 is a sketch of the image of the viewed structure.
4. Specific implementation.

See Figure 1-6. The component names are as follows: ladder 1, ladder pole 2, upper sheave hook 3, slide wheel hook 4, cross hole 5, bolt 6, solid square bar 7, solid square beam 8, probe out section 9, a ladder bar 10, ladder beam 11. A power line adjustable soft ladder head, including ladder 1 (overall), ladder beam 11. Each side of the ladder 1 ladder pole 2 upper and lower interval arrangement is arranged up, down wheel hook 3, 4 (for the upper and lower hanging points connected to the wire). Up and slide wheel hook 3, 4 between the ladder 2 using the activity adjustable length, two body docking structure. Upper sheave hook 3 has a down-connected section of the ladder 10. A rung 10 lower end connected a solid square bar 7 (see Figure 1, 3, 4). Solid square bar 7 multiple cross holes along the top and bottom with intervals 5. Corresponding to the slide wheel hook 4 upper end fixed connection has a section of the solid square beam 8 (see Figure 5, 6). Solid beam 8 out of 9 on the top, bottom, two cross hole arrangement 5. Secure by bolt 6 solid square bar 7 and solid square beam 8 connection. Move the bolt to insert a different crosshole 5. Realize the upper and lower wheel hooks between 3, 4 distance adjustable. Adjust the spacing of the upper and lower hook pulleys by selecting different bolt crossing holes 5 (adjustment holes) and bolting connections to the lower connectors. This enables the need to hang on double split conductors at different spacing spacing.

When used, two upper sheave hooks 3 hang on the upper wires and two slide wheel hooks 4 on the wires below. Depending on the distance between the two wires, the distance between the upper and lower wheel hooks 3 and 4 can be adjusted appropriately to meet the needs of field use. This design of a set of soft ladder head can replace a variety of specifications of soft ladder head, with strong versatility, easy to use, reduce tool equipped, cost-saving characteristics.

This design can also be used on the upper and lower wheel hook3, 4 between the ladder rod, forming a telescopic rod structure, and then the middle by the cross-insert bolt positioning fixed.

5. Conclusions

The utility model transmission adjustable transmission line adjustable soft ladder head structure is simple, flexible and convenient. It can be used on a single wire, or on a double split wire at different spacing points. It’s true versatility[13-14]. It reduces the labor intensity of the workers working at high
altitude, and improves the safety factor and work efficiency of the work. It plays a great role and significance to the service operation of transmission line.

References
[1] Singh S, Bandyopadhyay M N. Dissolved gas analysis technique for incipient fault diagnosis in power transformers: A bibliographic survey[J]. IEEE Electrical Insulation Magazine, 2010. 26(6): 41–46.
[2] Zheng R, Zhao J, Zhao T, et al. Power transformer fault diagnosis based on genetic support vector machine and gray artificial immune algorithm[J]. Proceedings of the Csee, 2011, 31(7): 56–63.
[3] Bacha K, Souahlia S, Gossa M. Power transformer fault diagnosis based on dissolved gas analysis by support vector machine[J]. Electric Power Systems Research, 2012, 83(1): 73–79.
[4] Kan H, Miyamoto T. Proposals for an improvement in transformer diagnosis using dissolved gas analysis (DGA)[J]. IEEE Electrical Insulation Magazine, 1995, 11(6): 15–21
[5] Fei S W, Zhang X B. Fault diagnosis of power transformer based on support vector machine with genetic algorithm[J]. Expert Systems with Applications, 2009, 36(8): 11352–11357.
[6] Sherif Ghoneim. A New Approach of DGA Interpretation Technique for Transformer Fault Diagnosis[J]. International Journal of Electrical Power & Energy Systems, 2016, 81(1): 265–274.
[7] Duval M. Dissolved gas analysis: It can save your transformer[J]. IEEE Electrical Insulation Magazine, 1989, 5(6): 22–27.
[8] Ward S A. Evaluating transformer condition using DGA oil analysis[C]// Electrical Insulation and Dielectric Phenomena, 2003 Report. Conference on. IEEE Xplore, 2003: 463–468.
[9] Bhalla D, Bansal R K, Gupta H O. Function analysis based rule extraction from artificial neural networks for transformer incipient fault diagnosis[J]. International Journal of Electrical Power & Energy Systems, 2012, 43(1): 1196–1203.
[10] Muhamad N A, Phung B T, Blackburn T R, et al. Comparative Study and Analysis of DGA Methods for Transformer Mineral Oil[C]// Power Tech, 2007 IEEE Lausanne. IEEE, 2007: 45–50.
[11] Jeong S, Murayama M, Yamamoto K. Efficient Optimization Design Method Using Kriging Model[J]. Journal of Aircraft, 2005, 42(2): 413–420.
[12] LIU Qiang, WANG Chengen. Pipe-assembly approach for aero-engines by modified particle swarm optimization[J]. Assembly Automation, 2010, 30(4): 365–377.
[13] Hu W P, Yin X G, Zhang Z, et al. Fault diagnosis of transformer insulation based on compensated fuzzy neural network[C]// Electrical Insulation and Dielectric Phenomena, 2003 Report. Conference on. IEEE Xplore, 2012: 273–276
[14] Hinton G, Vinyals O, Dean J. Distilling the Knowledge in a Neural Network[J]. Computer Science, 2015, 14(7): 38–39.