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DETERMINATION OF THE LOCATION OF CABLE LINE DAMAGE BY THE OVERHEAD FRAME METHOD

Dudina M., 12 MB EE **e-mail: dudinamariatl@gmail.com**
Dinabursky V.S., 12MB EE **e-mail: dinovlad1324@gmail.com**
Koval O.U., language adviser **e-mail: koval.olga7977@gmail.com**
Tavria State Agrotechnological University

The article is devoted to the analysis of the method of the overhead frame, which is a kind of induction method, used in the search for damage on cable lines.

Стаття присвячена аналізу використання методу накладної рамки, який є різновидом індукційного методу, що застосовується при пошуку пошкоджень на кабельних лініях.

Problem setting. In the process of operating cable lines, they can cause various damage. The restoration of the cable transmission line in many cases is delayed due to significant difficulties in determining the place of damage. The choice of method for determining the location of cable damage depends on the nature of the damage and the transient resistance at the site of the damage.

By the nature of damage in the three-phase cable lines distinguish the following types: damage to the insulation, causing the closure of one phase to the ground; damage to the insulation causing the closure of two or three phases to the ground or two or three phases with each other; breaking off one, two or three phases without ground or with grounding both torn and not ragged cores; inflow isolation breakdown; damaging the line simultaneously in two or more locations, each of which may belong to one of the above groups.

Similar types of damage can be found in four-wire cable lines up to 1000 V. [1] Finding methods that provide the exact location of different types of cable damage is an urgent task.

Analysis of recent research. At first, the damage zones are determined on cable lines, and then the damage location is specified directly on the track.

In order to determine the zone of damage to the line in practice, the relative methods are used: pulsed, oscillatory discharge, loops and capacitances.

To determine the location of damage directly on the track is recommended to use the absolute methods: inductive, acoustic and method of the frame.

Common disadvantages of known methods for determining the location of damage are:

- the dependence of the search results on the operator's experience and qualifications;
- the complexity and preciousness of equipment and ways of determining the place of damage;
- significant time (3-5 h) fault finding;
- the need to burn the isolation of the cable cores to the transient resistance is less than 100 ohms, which shortens the life of the cable lines.

The purpose of the article. The purpose of this article is to analyze the use of the overhead frame method for determining the damage on cable lines.

Basic material research. The method of the overhead frame is used when the metal is short-circuited one cable on the sheath and the short-circuit of the two cable strands, when it is impossible to create a spark discharge at the site of damage. Also, this method is used to determine the location of damage openly laid cable lines (in rooms, tunnels, cellars, etc.). In addition, this method can also be used for cable lines laid out in the ground - on the open trench or specially opened trenches along the route line to determine the damages on cables with separately lead cores. In this case, it is necessary to carry out excavation of several trenches in the zone of damage to the cable. It can also be used on cables with belt insulation in the case of breakdowns of one core on the shell or several with a large transient resistance. In addition, the method of the overhead frame can be determined by the disconnected cable, for example, to repair the cable lying in the bundle of other cables. [2, 3]

The method is as follows. After connecting the generator to the cable, put a frame with the phone and turn it around the cable axis. If the measurement is made before to the location of the damage, then two maxima and two minima of the sound signal will be listened to one frame rotation. A monotone sound will be heard at the location of the damage when turning the frame (Fig. 1).

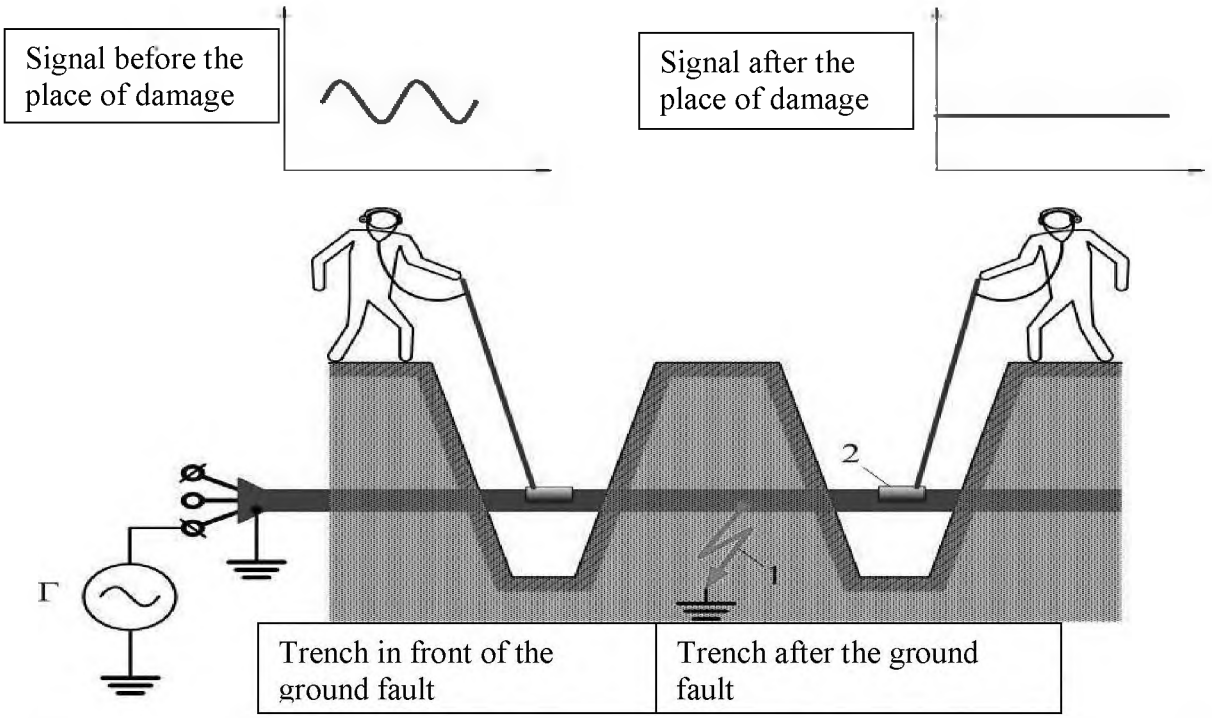

Figure 1 - Locating the short circuit to the ground using the waybill: 1 - place of ground fault; 2 - overhead frame.

This method is particularly convenient in open method of laying a cable or in determining the finding of damage within a torn trench. On the closed track trenches break off at the boundaries of the alleged location of the damaged cable. After allocating the area between the trenches, where is the damage, by the next tranche can accurately determine the damage to the cable. An acoustic frequency generator (800-1500 Hz) is connected to the damaged housing, and the current is established through the place of closure in the sheath of 1-5 A. The cable found in the trench is superimposed on the overhead frame with the main telephone attached to it, and when the frame is rotated around the axis the cable's listening is determined by the nature of the sound change from the electromagnetic field. The frame is arranged in such a way that its winds are assembled into a tight harness, curved around the perimeter of the frame frame made of iron in the thickness of 3-4 mm. The electromotive force is shown in the turns on both sides of the frame, and consequently, the resulting EMF changes when the frame is rotated.

Using this method requires the following equipment: overhead frame, amplifier, telephone handsets.

The frame is made of a PE wire with a diameter of 0.01 mm with a number of winds n = 300-400, and the winds are assembled in a solid harness and the frame is covered with a steel cover on top, which serves as a screen protector for the frame from magnetic fields caused by external sources of current (Figure 2).

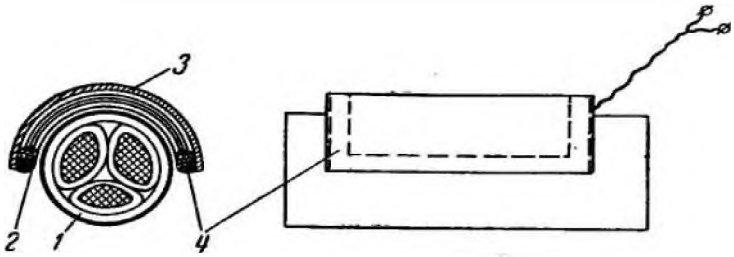

Figure 2 - Design of the overhead frame: 1 - cable; 2 - screen; 3 - a steel yoke; 4 - coil of 1000 winds, ø = 0.07 mm.

The "Search-1" device, based on measurements near the air lines of the higher harmonic components of the magnetic field of the current line, in the presence of ground, is used to determine the ground-to-ground location in the air devided networks of 6 to 20 kV. Measurement is carried out at a distance of 6 to 8 meters from the line axis. Indication of the device, when measuring all lines, leaving the substation will be maximized on the damaged line. Sequential measurement along the damaged line or branch from the line allows you to determine the location of the circuit, because after it the readings of the device are sharply reduced.

If the listening is carried out without an amplifier, then the number of winds in the frame is determined from the most advantageous ratio between the frame resistance and the resistance of the phone.

In order to reduce the impact of interference from foreign fields, the frame is shielded from above by the steel casing, and on the lower side it is protected from mechanical damage by a brass sheet. The connection of the frame with the phone is shielded wire.

The method of overhead frame has advantages: it is easy to use, reliable, does not require bulky equipment and is easily transported. This method is particularly convenient in open method of laying a cable or in determining the finding of damage within a torn trench. However, this method allows effectively to find the location of cable damage with transient resistance of no more than few Ohms and the length of the cable at the place of damage to 1 km.

Conclusion. The analysis of the method of the overhead frame will ensure proper determination of the location of the cable damage in the work and the disconnected cable. The method is very relevant and widely used.

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